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Communications of the Association for Information Systems



Mobile Applications Development on Apple and Google Platforms

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Abstract:

The uptake of Internet-enabled multifunctional mobile devices is an emerging area within software development. This article examines the under-researched area of mobile application developers and considers some of the current challenges facing this sector within the IT workforce. We frame our study within the wider context of the evolution of the industry in order to illustrate how the emerging business model of mobile application development shapes the everyday practices of systems developers, specifically those working on iPhone and Android platforms. Drawing on qualitative research carried out in Sweden, the UK, and the U.S., we analyze developers' experiences in order to illustrate how they respond and adapt to the turbulent environment of the IT sector.

Keywords: mobile applications development, Apple, Google, Android, iPhone, developers

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I. INTRODUCTION

Since the mid-1980s the global telecommunications industry has become one of the core industries of the world economy, and within this the mobile phone industry has become the most important sector [Hess and Coe, 2006]. When the first mobile phone was launched in the late 1970s, it seemed unlikely it would ever reach a mass market audience. Although it could be argued that today the mobile phone is a familiar technology, it remains a moving target as it continues to evolve and change [Gebauer et al., 2010; Woolgar, 2003]. As with any emerging technology, it is difficult to predict how the device will be adopted and used, hence the widespread speculation about its effects and implications. Few could foresee that a technology designated for voice communication would be adapted to such an extent for text messaging; likewise, the potential of mobiles as Internet-enabled multifunctional devices to potentially threaten the dominance of laptops and desktops is yet to be unravelled.

Within the mobile sector there are numerous stakeholders with differing perspectives [Sawyer et al., 2003]. The aim of this article is to explore some of the current challenges facing the IT workforce by examining the practices of mobile application developers. To focus only on the organizational level, without paying due consideration to wider structural forces, merely “black boxes” the wider influences that shape systems development; there is also a pressing need to incorporate broader socio-economic developments [Pollock and Williams, 2009]. Therefore, in this article we examine two large IT firms—Apple and Google—in order to situate developers within this wider context and the emerging business model of mobile application development and distribution (MADD). This is important to developing an understanding of how these broader dynamics shape the environment within which software developers exist. We draw on qualitative data to highlight the practices of developers that are adopted in response to the strategies of these large technology firms; this sheds light on the mechanisms that developers employ in their continuous adaption to an environment that is subject to perpetual change.

We focus the research by concentrating on the Apple and Google platforms, given their prominence within the IT sector and because of their increasing position as market leaders for mobile platforms. The following section will discuss these high-tech firms by offering an overview of the evolution of the iPhone and Android platforms. Next, the article describes the qualitative research approach that was adopted for the fieldwork that was carried out among sixty iPhone and Android developers. The analysis follows, which illustrates MADD in terms of the categories of who, what, when, where, why, and how. Finally, conclusions are drawn which point to the precariousness of creative work in the IT industry, a turbulent environment that is susceptible to permanent restructuring and change.

Technology Firms and Markets: Apple and Google

In this section we outline the broader context that frames MADD. Understanding IT work requires an appreciation of how wider socioeconomic trends and developments in product and technology markets frame working practices. We provide a brief history of Apple and Google in order to position them within the mobile applications market, particularly regarding their respective platforms of iPhone and Android.

Apple was established in 1976 and has had a chequered business history. Much of its recent success and enhanced market share can be attributed to the emergence of innovations like the iPod, iPhone, and iPad. When the iPod was launched in 2001 it was soon to become the “de facto dominant design” [Dedrick et al., 2009] in a chaotic digital media player market. By contrast, when Apple launched the iPhone in 2007, the state of the mobile phone industry was one of maturity and sophistication and was dominated by five companies that covered around 75 percent of the world market for handsets (Nokia, Motorola, Samsung, Siemens, and Sony Ericsson) [Hess and Coe, 2006]. Apple benefited from competitive price wars within the industry, which has seen reduced margins for voice transmission and far higher profit levels with data transmission [Vogelstein, 2008]. Their entry into the mobile phone market with a product equipped for regular Internet access enabled Apple to become dominant within a relatively short period of time, while competitors (like Nokia) reported their worst ever financial results [Wray, 2010].

Apple is renowned in the IT industry for extreme secrecy surrounding new product launches and the speculation that this fosters adds to the anticipation. Steve Jobs’s (former CEO) annual Apple keynote address became a media event for the marketing of new products until 2011 when he retired a few months before his death. When the iPhone was unveiled it was perceived as representing something distinct in the more established market of mobile phones [Ling and Sundsoy, 2009]. The product launch was backed by a successful marketing campaign, with staged launches outside their retail stores, often consisting of long queues of young, hip-looking film extras that were paid

by Apple to generate interest in the product [Goggin, 2009]. The iPhone was marketed as representing a seismic shift in mobile telephony: “a revolutionary mobile phone, a widescreen iPod with touch controls, and a breakthrough Internet communications device with desktop-class email, Web browsing, searching, and maps”.¹ Three months later, Apple launched the iPod Touch, and announced that both products would be the first handheld devices with wireless access to the iTunes store, thereby enabling content to be purchased and downloaded directly on the devices.

As the lead firm, Apple is the only company that negotiates with other firms in their supply chain, gaining power by using multiple sourcing and working closely with even the suppliers’ suppliers [Dedrick et al., 2009]. Their artifacts are embedded into a highly centralized and integrated ecosystem that seamlessly links products with the marketplace (iTunes, the App Store). This infrastructure provides a key resource for the rapid roll-out and uptake of applications in the international marketplace, since (regulatory and financial) structures were already in place to facilitate ease of download and purchase.

In keeping with their centralized strategy, Apple manages the entire distribution channel for mobile phone applications. In March 2008 they announced they would control the value chain from application development through to distribution, with the release of the iPhone Software Development Kit (SDK) which enables third-party developers to create applications. The creation of the App Store—not dissimilar to iTunes and thereby building on consumer confidence—enables users to search, purchase, and wirelessly download applications directly onto their device. The App Store provides developers with a direct link to users, as they determine the price for the application and retain 70 percent of all the sales revenues, with Apple covering credit card, Web hosting, and infrastructure costs. This process is mediated by Apple which maintains firm control over distribution and can halt the release of applications if the company deems them to be inappropriate or unsuitable. If applications are declined, there is no feedback beyond the simple rejection. In September 2010 Apple bolstered their control with the release of 113 review guidelines which provide acceptance criteria covering technical information, privacy, religion, gender, trademarks, and more.

Google was established in 1998, and its income stream is based on advertizing revenues generated from associations with keyword searches. As a firm that is keen to enter new markets, Google has been involved in numerous mergers and acquisitions, with a particular focus on small venture capital companies (such as Earth Viewer [now Google Earth], YouTube, Double Click, Grand Central [now Google Voice]). However, not all of its endeavors have been well-received or lucrative (e.g., Google Books, Gmail, Google’s presence in China which provided politically sanitized searches on Google.cn), and Google failed to spot the importance of popular social networking trends, such as Facebook and Twitter [Auletta, 2010]. In search of the “next big thing,” Google is now looking to the area of mobile technology. Given Apple’s rise to popularity, a strategy is needed that offers differentiation if it hopes to gain a sizeable market share.

Google announced its open source Android platform for mobile phone development in 2008. This was initially developed by a small start-up company (Android, Inc.) in Palo Alto that developed software for mobile phones; the firm was purchased by Google in 2005 and the co-founders moved across. The unveiling of Android was announced at the same time as the founding of the Open Handset Alliance (OHA). This business consortium, led by Google, consists of around fifty technology and mobile firms (such as Telecom Italia, Samsung, Motorola, LG, Vodafone, and Intel) that are committed to advancing open standards for mobile devices. In contradistinction to its name, membership of the alliance is not publicly open and is based on personal invitation from Google [Grottnes, 2009].

The first joint project of OHA is Android. By joining forces with mobile phone handset makers and carriers, Google has managed to pull together a diverse range of technology manufacturers who are willing to develop products that support the Android platform, thereby potentially spurring its growth with a broad industry base while generating higher revenues for the operators. The founding of the OHA suggests that Google is aiming to have its operating system available across a wide range of devices and carriers, unlike Apple whose platform is centred on a high-end product where the software is inseparable from the hardware. It seems unlikely that Google will aim to compete with a premium price product like the iPhone, and the OHA’s declaration that “Building a better mobile phone would enrich the lives of countless people across the globe” [Open Handset Alliance, 2009] suggests that the strategy is one of global distribution of a more economically accessible product. This is of particular interest given the increasing adoption of mobile devices as the United Nations Report on the Information Economy [2009] points to mobiles emerging as the preferred ICT tool, with rapid increases in the numbers of subscriptions, particularly within developing economies.

¹ www.apple.com/uk/pr/library/2007/01/090106_iphone.html

Both Apple and Google operate in an environment that is turbulent, competitive, and in a process of global development. Their search for new ways to create profits means that expansion comes in various forms and can include the development of new commodities that were previously unavailable; spatial expansion into new parts of the world (particularly developing countries); and new forms of labor [Huws, 2006]. In the case of iPhone and Android, we witness the creation of new products, the potential to expand market penetration into different parts of the world, and a novel way to tap into the creativity of expert labor, while avoiding any of the associated costs of direct employment. For mobile applications to remain successful, new creativity is constantly required, as the failure to innovate carries the risk of eventual displacement from the market. The creation of mobile application stores by Apple and Google effectively outsources product development as an open call to a global base of developers and amateurs that may wish to participate. This form of crowdsourcing has been aptly named “milking the masses for inspiration” by *Business Week* [2006].

II. RESEARCH APPROACH

Research Design

In January 2009 we embarked on a study of developers’ experiences with a view to understanding the emerging and under-explored area of MADD. While qualitative research methods were used, the epistemological assumptions are more broadly interpretive [Orlikowski and Baroudi, 1991; Walsham, 1995] as we attempt to understand phenomena through the meanings that people assign to them as a result of human sense-making activities. Given the lack of academic literature in the area, the study was exploratory in nature and focused on the everyday work practices and experiences of mobile developers. One of the strengths of qualitative research is that it allows for greater flexibility with the sampling in response to the emerging shape of the research project [Silverman, 2005]. Therefore, follow-up interviews with some past participants as well as interviews with new respondents have taken place in order to understand how the field is changing over time. The approach is inductive in that no particular theory was specified a priori as a means of guiding the data collection and analysis. Throughout the process of analysis a number of relevant theories have been considered to provide an appropriate frame for making sense of the empirical observations; this has resulted in a number of articles with different foci.

The study was based in Sweden, the UK, and the U.S. since these markets have significant levels of maturity in terms of handsets and the mobile application marketplace. For example, within the Android market, 65 percent of applications originate from U.S. developers, 20 percent from the Euro zone and 12 percent from the UK² [Distimo, 2009], which is reflective of the timeline when paid applications became available in these countries. These markets and occupations are defined by the policy context within which they operate and there is “regulatory difference” that has produced considerable variation among advanced economies [Christopherson, 2004]. While we are sensitive to these differences, they are beyond the scope of this article.

Given the absence of any comprehensive list of mobile developers, random sampling was impossible, and so we adopted an organic sampling practice that was strategic [Mason, 2006], in that we aimed to encapsulate a relevant and illustrative range of contexts, rather than focus on empirical representation. Given the research is exploratory, we wanted a meaningful range of development contexts, experiences, and perspectives that would allow us to develop key understandings and explanations about this emerging area, rather than statistical comparison. We aimed to include developers involved in a range of different activities, with varying amounts of experience and with a variety of contracts and employment statuses. Consequently, the sample is diverse, consisting of a mixture of permanent employees, freelancers, and entrepreneurs, and also including a couple of people who developed applications as a “sideline.” While not intending to imply that the participants are representational, we aimed to construct a sample that displays characteristics that are in similar proportions to the wider population of software development.

Data Collection

Overall, sixty developers participated in the study, and this broke down as fifty-five males and five females. We began with a pilot study that involved two face-to-face focus groups, each consisting of six Android/iPhone developers based in Sweden. This provided a vantage point from which to launch the broader study, feeding into the development of a semi-structured interview guide. We used this to ensure that all areas salient to the research were addressed, but were conscious of flexibility being one of the great strengths of qualitative research. The early interviews contained more open-ended questions than the later interviews which tended to focus on more specific issues. The recruitment process involved various channels, including posting advertisements on forums, online communities, and blogs, as well as sending personal messages via e-mail and Facebook; the criteria we used was that participants were either Android or iPhone developers and had published at least one application. The IT

² Obviously the UK is in the Euro zone, but Distimo separated this out in order to highlight the different trajectories and uptakes.

industry is notorious for the under-representation of women [Adam et al., 2006], and so effort was placed into recruiting developers from the social network “Girl Geeks.” Given the participants were either self-selected via electronic networks or part of a snowballing process, we acknowledge that a limitation of the study is that they are not representative of the population of mobile developers in a statistical sense. However, our intention was to understand how developers make sense of their world, rather than survey them in order to test hypotheses. Reflective of the nature of the IT sector more generally, which is characterized by a multitude of firm types, we opted not to study one organization, and in this respect the research is neither organizationally nor spatially bounded.

We experimented with a mixture of face-to-face, co-located interviews, synchronous Skype interviews, as well as asynchronous online discussion forums (Table 1). The format selected depended on the informants’ preferences and their geographical location. While the use of different technologies may have impacted the response, we worked from the assumption that IT workers are familiar with numerous modes of electronic communication. Respondents may have preferences for particular modes of communication, so offering a multiplicity of channels hopefully enabled us to reach a broader cross-section of developers. Each interview lasted from one hour to over two hours in length; all were taped and transcribed verbatim. The questions covered a range of topics including the respondents’ current working practices, their reasons for developing mobile devices and attraction to particular platforms; their experience of the platforms; the development process itself; and marketing and publishing strategies. Three online forums were created solely for the purpose of this project (the first with seven iPhone developers; the second with eighteen Android developers; and the final one was mixed with two iPhone and two Android developers). The forums lasted for ten days with a new question posted every working day. Every participant answered each question and often commented on each other’s answers, thereby generating debate in a similar way to a focus group. This proved a successful technique as one question per day was not perceived as an onerous task, and so the response rate was excellent (100 percent).

Table 1: Number and Type of Interviews Conducted

Participants	Date	Residence	Format
2 Android developers	May 2009	Sweden	Skype focus group
2 Android developers	May 2009	Sweden	Face to face interviews
1 Android developer	May 2009	Sweden	Face to face interview
1 Android developer	May 2009	Sweden	Skype interview
1 Android developer	June 2009	UK	Skype interview
1 Android developer	June 2009	UK	Skype interview
1 iPhone developer	June 2009	UK	Skype interview
1 Android developer	June 2009	UK	Skype interview
1 Android developer	June 2009	UK	Skype interview
1 Android developer	June 2009	Sweden	Skype interview
1 Android and 1 iPhone developer	June 2009	UK	Face to face focus group
2 Android developers	June 2009	UK	Skype focus group
7 iPhone developers	Sept 2009	USA	Online forum
18 Android developers	Sept 2009	USA	Online forum
2 iPhone and 2 Android developers	Sept 2009	USA	Online forum
2 iPhone and 2 Android developers	Aug 2010	Sweden	Face to face focus group
2 Android developers	Sept 2009	UK	Face to face focus group
1 Apple developer	Sept 2009	UK	Face to face interview
1 Apple developer	Sept 2009	UK	Face to face interview
2 Apple developers	Sept 2009	UK	Face to face focus group
1 Apple developer	Sept 2009	UK	Face to face interview
1 Apple developer	Sept 2009	UK	Face to face interview
2 Apple developers	Sept 2009	UK	Face to face focus group
1 Apple developer	Sept 2009	UK	Skype interview

Data Analysis

The process of data collection and analysis occurred dynamically and interactively. Analyzing and interpreting the interview transcriptions using coding were facilitated by the qualitative data analysis tool, NVivo, which was used to store all of the data collected. The method of analysis was based on an ongoing iterative process of reflection to help identify concepts, themes and issues [Miles and Huberman, 1994] based on frequent discussion by the two researchers. This was informed by our focus on everyday work practices and experiences, while remaining alert to emerging issues. In the initial coding, virtually every passage of the transcripts was associated with one or more codes of recurring topics. A set of higher-order categories was then developed to aggregate the codes into broader themes. For example, the higher-order code “motivations,” consisted of contributions from first-order codes such as

“autonomy,” “technical challenge,” “generating income,” and “recognition.” The initial findings and themes were also shared with a broad sample of participants from the study, and their helpful comments confirmed and verified these themes, yielding additional insights. The reaction of practitioners in the field is seen to offer a crucial validation of the interpretation [Klein and Myers, 1999]. In order to ensure representativeness, the quotes have been selected from the full range of sites and are chosen as typical views. In the interests of anonymity, names of participants and their workplaces are not cited. The findings are exploratory and are intended to generate insights into the emerging trends and practices that shape MADD.

III. FINDINGS

Given the absence of academic research on mobile applications developers, in this section we provide a broad synopsis of the area in order to link the micro-level of the developer experiences with the emerging business model of MADD, predominantly shaped by Apple and Google. While a number of themes emerged from our data analysis, in this article we have chosen to outline our findings by drawing on an organizing framework that was adopted in one of the early papers that provided a foundational framework for understanding open source software (OSS) [Feller and Fitzgerald, 2000] at a time when little was known about OSS in academic circles. This analytical framework was derived from a combination of two frameworks that have been influential in IS research: Zachman’s [1987] framework for the development of IS architectures (ISA) along with Checkland’s [1981] CATWOE technique as part of Soft Systems Methodology (SSM). The rationale for merging these approaches is that Zachman’s framework is strong in the area of functions and processes while Checkland places greater emphasis on people. The framework, therefore, is particularly useful for delineating an emerging research area and mapping out the various facets that encompass developers and the development process, all of which are situated within a wider environment. It offers the following categories: who, what, when and where, why, and how. These categories are sufficiently broad for an exploratory study and have been summarized in Table 2 with an analysis of each of the categories discussed in the following subsections.

Analysis of the Who of Mobile Application Development

This category covers multiple stakeholders, which is reflective of its origins within SSM and includes clients, actors, and owners. In relation to the developers, they all had extensive coding experience and platform knowledge. Their publishing experience spanned from one to more than forty applications, with around half of them having published between ten and forty applications. Most of the developers tended to opt for single platform development in order to focus their expertise, although some developed across multiple platforms. Some developers worked on outsourced applications, whereby a third-party organization commissioned work on their behalf, but the majority “owned” the product they were developing. There were differences in levels of success and the amount of revenue generated. The number of downloads for their most successful application ranged from over 1m to just over 10,000, but there were examples of some applications receiving zero downloads. Overall, the amount of revenue they had generated varied widely—from \$150,000 from one application to just \$50 for a developer with six applications. The sample consists of a mixture of permanent employees, freelancers, and entrepreneurs, including a couple of people who developed applications as a sideline. Around 40 percent were self-employed with over two-thirds working in small start-ups; this group of developers were far more likely to work longer hours and forgo some of their leisure time for mobile development. The majority were aged between twenty-five and thirty and had all studied technical programs at college. In order to provide further context, some brief vignettes are presented in Table 3.

While developers own their product and the associated intellectual property rights, they do not own the distribution channel, which is key to disseminating their artifacts. Developer access to the marketplace for the sale of applications was opened up by Apple and Google, and, while this was viewed positively by many mobile developers,³ it is entirely within the control of Apple and Google. In this respect, developers operate as commodity producers, while giant technology firms are positioned at the apex of the industry, controlling the stores that showcase and market applications into merchandise for a global audience. Numerous participants commented on the difficulties that lack of control created, particularly with regard to transparency and consistency:

One thing we would like is transparency and sadly even Google and Android have failed on this. We would like to know when the latest operating systems come in. We would like to know why our application failed the App Store process. We would like to speak with people who failed our application and explain that they are wrong. We would like the process not to take two weeks. Google promises that they will release a new version of the operating system and they don't. They never respond to bug requests. They never respond to anything.

Android/iPhone developer, UK

³ Previously the operators retained between 50 and 70 percent of the content revenue.



Table 2: Framework Analysis of the MADD Approach

Who (Client, Actor, Owner)	
Who are developing and distributing mobile applications?	Demographic profiles are comparable with OSS developers in that they are predominantly male, aged 25–30, with strong technical backgrounds and technical education. There is a diversity of employment backgrounds, ranging from hobbyists to professional firms specializing in MADD (such as Rovio Mobile). One common feature is the predominance of small firms and start-ups often looking to enter new markets.
Who are the owners of the MADD platforms?	Based on highly centralized control by large digital firms who provide the platform (in this example, Apple and Google, but also extends to firms such as RIM, Orange, Nokia). This includes the development environment as well as the mode of distribution.
Who are the users/ consumers of mobile applications?	Mass consumers are the primary audience of products and services with limited examples of niche or specialist offerings (e.g., vintage-style computer games). Numerous organizations are increasingly extending their service offerings to customers to include mobile applications (e.g., flight check-in, financial services).
What (Transformation)	
What defines a mobile application?	Software products and services that are available on a handheld mobile device ranging from phones to tablet computers.
What types of products and services are typical of mobile applications?	There are various categories of applications available with games predominating. Applications can be either free or paid, with free applications more often receiving greater downloads. Paid applications follow defined price structures but are largely low cost.
When and Where (Environment)	
What are the temporal dimensions of MADD?	MADD is characterized by rapid development since first-mover advantage is crucial. In order to increase downloads, some applications offer frequent incremental releases and updates.
What are the spatial/ geographical dimensions of MADD?	Developers tend to work in close physical proximity, often clustered in large city centers with active face-to-face social networks. While online forums provide useful advice and support, there is a strong physical presence with developers either working in small teams within small firms or as individuals.
How	
How is the development process organized?	While there is no prescribed methodology that is being followed, developers often follow a similar set of logical phases and stages, with varying levels of emphasis on initial market research and the marketing of completed products. Given the predominance of small teams and individuals, the development process tends to be holistic and informal as opposed to fragmented with a clear division of labor.
What tools are used?	The integrated development environment, which is hosted by Apple or Google, provides numerous tools to write, test, and deploy applications on the target platform. This includes SDKs, APIs, debuggers and emulators.
Why (Weltaanschauung or Worldview)⁴	
What is the weltaanschauung of the platform providers?	MADD has enabled Apple and Google to quickly become dominant players in the mobile market. Mobile applications have expanded mass perceptions of the value of mobile devices, thereby creating new markets. The MADD platform is highly innovative, in that it has provided a novel way to tap into the resources of expert labor on a global scale, while avoiding the direct costs of employment.
What is the weltaanschauung of the developers?	Many of the motivations are difficult to classify into categories, such as technological or economic, since they are multiple and multilayered and cannot simply be “black boxed.” Participation in MADD enables continuous competence and career development in order to remain employable. New markets (that were previously closed or difficult to access) have the potential to generate revenue. Working on an open source platform (in case of Android) has appeal to some developers.

⁴ This assumes homogeneity. While platform providers such as Apple and Google profess a clear strategy and direction, conveying the view of the CEO and the board of directors, the same cannot be said for the diverse spectrum of developers. However, common patterns and trends have emerged, and we point to these.

Table 3: Developer Profiles

Anders is a single, twenty-seven-year-old Android developer from Sweden who recently graduated in computer science. He has experience developing Java and .NET and is currently employed by an IT firm that is not developing mobile applications. Anders began developing applications in his spare time and was attracted to Android because it was a cheaper alternative to the iPhone and because he liked the open source aspect which built on his previous experience with Java. The potential market of Android via the Google brand was also an important factor. He has solely developed and published one free application and his main motivation for doing so was that he thought people would like it. Anders offered the application for free in order to get as many downloads as possible, and this currently stands at 40,000.

Yusuf is thirty-eight-years-old and lives in the UK with his wife and child. After graduating he set up his own company, which he ran for seven years. However, when he started a family he felt that running a business was too onerous and sold the company, preferring to work as an independent software developer. He became interested in Android when Google announced the platform, which he described as “extremely well-engineered.” He is attracted to open source, since this provides a means for distributing his work to “potentially millions of people,” as well as being “morally satisfying.” He has developed a number of applications, all of which have been available for free, but now his main motivation is “to make money.” His incentive for publishing free applications was to gain experience from the process and for user feedback on the applications. He is now looking to capitalize on his expertise.

Mike is thirty-one years old and lives with his partner in the U.S. He has a computing degree and runs a small start-up company with two colleagues. He is developing applications for mobile devices because, even though mobile devices currently have a small market share when compared to desktops, potentially they have many uses given their portability. He has developed and distributed five applications on the App Store and tends to develop the applications on his own. He chose the iPhone platform because of the appeal of the device and the touch interface, which offers numerous design possibilities, and because the store offers access to a huge marketplace. He enjoys the programming experience, as well as the potential profits that may be generated from selling applications.

The lack of influence was not just about feeling alienated from the process, but also impacted their work experience, to the extent that modifications to the platform can have adverse effects on their products. One U.S. iPhone developer explained this as follows:

When Apple releases a new version of an operating system their idea of transparency is just to put a note “Bug Fixes” and they never tell us what is really going on and what is being fixed. Sometimes they fix and change things and this then breaks our apps! So that is the real problem—transparency and consistency.

The industry is defined by outputs and the types of products that are available, yet the market also consists of unpredictability and flops. This highly uncertain environment requires a constant stream of new products with the potential for mass sales, especially as mobile applications suffer from quick rates of obsolescence. One study suggests that of the users who download free applications from the App Store, only 20 percent use the app the following day, and this continues to decrease over time. With paid applications, the return rate is only slightly better, with 30 percent of people using the application the following day [Chen, 2009].

If we consider other creative sectors, such as film and television, we can see that making a product available to the wider market is a costly commitment (in terms of production, marketing, promotion, and distribution) and so the decision as to whether or not to back an enterprise is presented as highly considered. However, if we compare this with MADD, most of the cost—in terms of training, product research, development time, and promotion—is borne entirely by the developers themselves. Arguably, the App Stores provide a means for distributing products, but this simply represents dedicated electronic space for transactions. Seemingly more problematic for iPhone developers is that Apple retains 30 percent from each transaction and maintains ultimate control in deciding whether applications can be released. As the quote indicates, some are rejected: “Occasionally we have had apps refused for no reason. You have heard all the horror stories and they apply to us” (iPhone developer, UK). One developer was irritated by the lack of transparency:

Another problem is the inconsistency at the App Store approval process. They actually rejected us once for a feature that wasn’t functional apparently. But we can actually see from their server logs that they had indeed tested it and it worked, but they said that it didn’t work, because they were doing it so quickly. They didn’t give it their full attention. We know countless people that have been rejected for crazy reasons....

In relation to users, there is little information available from the App Stores aside from the number of downloads and stores provide limited means for developers to respond to feedback. Developers broadly agreed that engaging in dialogue with users could be useful for enhancing upgrades and future products, but in reality there is insufficient interaction with consumers. Crucially, user reviews influence the rating system which impacts potential downloads. The difficulty in communicating with users was noted by a US iPhone developer:

The real challenge about the App Store is that you have no control over user feedback. Our apps are very tightly integrated with a number of user feedback systems because we are so paranoid that users can't respond to us directly. And if you look at the App Store reviews there are some incredibly good applications on the App Store that have been rated 1 or 2 stars because the users have misunderstood the advertising or misunderstood the screen show.... Not being able to give feedback to users who write stuff negatively on the App Store is a real, real, pain in the ass.

Mobile applications are an example of a contemporary development environment where production is clearly distinct from consumption, with many applications being of a "throwaway" nature as only 1 percent of users who download an application become long-term users [Chen, 2009].

Analysis of the What of Mobile Application Development

The *what* of mobile applications has been discussed in Section II, in the context of Apple and Google. This category also refers to the applications themselves, and so in this section we offer a brief overview of the various dimensions in the marketplace⁵:

- In terms of *genres*, there are twenty categories of iPhone applications ranging from games, music, lifestyle, and photography to weather, reference, and education. Within these categories, games are the most popular by far, accounting for more than 50 percent of the applications; they are followed by entertainment, utilities, social networking, and music [Distimo, 2010].
- With regard to *cost*, the proportion of paid applications on the iPhone is 73 percent, with 27 percent being free of charge. The average application price on Apple is \$3.62 and \$3.47 for Google [Distimo, 2009].⁶ However, as this figure is aggregated it also covers the highest paid applications which are medical applications (at an average cost of \$10.73), followed by business (averages at just under \$6) and books [Distimo, 2010]. This skews the figures since the largest category of games averages at around \$2 and there are many free applications available within this genre.
- Different *pricing models* may apply to the same products that are available across different platforms. For example, in October 2010, Gameloft offered two games (1 vs.100; CSI Miami,) with different prices for distinct platforms. They are three times more expensive on Android as compared to Apple (\$0.99 against \$2.99), which could be because Apple is at a different stage of maturity and has a far more crowded market.
- The number of *downloads* per application feeds into the ranking system. This is often price sensitive, as popularity can be closely correlated with cost as illustrated by the rapid increase in the popularity of the application World Cup Ping Pong (U.S.), which shifted from 92nd position when it was available for \$2 to sixth position for a period of ten days when the charge was reduced to \$1. While such changes are not always this drastic, there tends to be a fairly close correlation.
- With *application rankings*, the top 100 changes daily and a presence on the list considerably enhances visibility and downloads. When comparing the top fifteen monthly highest ranked paid apps for the App Store (U.S.) in August 2010 and October 2010, we find that only three of the fifteen remain the same; this figure is replicated in the top fifteen monthly highest ranked free applications. Comparing these figures with the Android market (U.S.), of the top fifteen monthly highest ranked paid apps, eight of the fifteen apps that were available in August 2010 remained in October 2010; for the monthly highest ranked free applications, nine of the applications stayed in the top fifteen during this period.
- While the most downloaded apps are priced between \$0.99 and \$3.99, the most revenue was generated by highly priced apps which charge around \$50, despite being downloaded less often. Certain categories tend to be especially costly, in particular navigation and traveling, reference and productivity. However, the most grossing apps are generally priced within the \$4.99–9.99 price bracket.

⁵ Data is not always equally available for Apple and Google, and there tends to be more available for the former, probably because it is a more mature market.

⁶ This compares with an average price of \$8.26 for Blackberry.

Analysis of the When and Where of Mobile Application Development

The environment is generally one of rapid development, but there are variances in time to completion, depending on the type of app, whether it is a “light” version, and if it is being developed on behalf of an outsourcer. Time to market is crucial, particularly if the artifact represents a new innovation, since developers do not want to find themselves replicating a similar application. Being the first in the marketplace is seen as key to success, which was described as follows:

The first mover advantage is extremely beneficial. If something is written once it's original, if it's written twice it's a cliché, and it is the same thing in software.

Android developer, UK

For some of the developers the enduring problem of time pressures continues to frustrate. This is evident in the response to the question on project development time:

Lately, it takes forever.... It's just too long. I think our first version, which was pretty basic, took three months of evenings for two people. Some really trivial applications you can do in a day, but ours are pretty complicated. Yes, months, a really, really long time.

iPhone developer, UK

Consequently, mobile development can be more time-consuming than other development arenas:

Developing on a mobile platform takes a lot longer than developing on the Web, and this is not just in terms of the code. We find there is approximately five times more code in an iPhone application than in an equivalent Web application.

iPhone developer, UK

In terms of *where*, geographically the developers tend to be dispersed, either working in (predominantly small) firms or as individuals. However, contrary to the assumptions that new media work can be carried out “anytime, anyplace, anywhere,” face-to-face relations remain worthwhile as developers create physical space in urban centers for regular meetings:

There is a social media café that meets on Friday mornings at the ICA in London. People can just turn up, they can just talk. It's often a mobile focus. You can turn up with a laptop and just work all morning and ignore everyone or you can have coffee and walk around, meeting everyone that you want to meet.

Android developer, UK

For many developers, participating in networks represents far more than a monthly meeting and they often contribute to numerous social networks with different purposes. These facilitate a continued labor supply for producers, removing the burden of a more costly and bureaucratized approach to recruitment and are seen as maximizing the likelihood that the appointment is reliable and productive. They enable developers to cope with highly fragmented labor markets and are formed by people working in informal and precarious conditions.

Analysis of the Why of Mobile Application Development

Business commentators suggest that the iPhone/Android platform have the potential to provide new business opportunities for small firms and individual developers, enabling them to enter new markets [Juniper, 2009]. The financial risk is fairly minimal, since the outlay for the SDK is negligible for the iPhone (\$99) and free for Android. The new technology, its capabilities, and the process of mobile development were viewed positively by many: “My main motivation to develop on the iPhone is because of the fun when coding for such a great device” (iPhone developer, U.S.). However, there were a number of critical voices, as one iPhone developer in the UK remarked:

I love the iPhone, but the reality of Apple lets me down relative to the dream they are selling. That is my problem with Apple, they sell a dream that they are only able to sell by brainwashing people.

A number of interviewees were developing mobile applications to enhance their technical portfolio and supplement their income. Of these, the majority worked in small companies that they themselves had founded. Some of the participants developed applications “as a sideline” for extra income and also because they hoped to accumulate experience and increase their visibility. An Android developer in the U.S. commented: “My goal is to create a portfolio of apps that demonstrate my skill and opens doors to paid positions in programming.”

Developers see themselves as being at the “cutting edge” of development and creating applications for mobile devices, as opposed to mobile phones. Apple and Google are recognized as leading brands, and developers described other Internet players as “lagging.” Aligning oneself with a strong commercial player is seen as

advantageous since their popularity offers a large addressable market, which is further supported by the App Store for distribution purposes.

When choosing whether to develop for the iPhone or Google (or indeed multiple platforms) our findings point to developers making choices that are based on pragmatic reasons, as opposed to an evangelical commitment to any one particular platform (see Table 4, which offers a summary of the benefits and drawbacks that were frequently referred to by numerous developers during the process of data collection). Many of the iPhone developers began to develop on this platform since it preceded Android and, therefore, they needed a strong rationale to convince them to switch. Many Android developers were drawn to mobile development because of the open source aspect which enables them to share and reuse code. Android developers expressed reasons for choosing *not* to go with Apple: namely, that the iPhone is “too controlled” with numerous conformance rules, a Mac is essential for development, and because developing an application may not always lead to acceptance for the App Store.

Table 4: Benefits and Drawbacks of Apple and Google

	Apple (iPhone Platform)	Google (Android Platform)
Benefits	<ul style="list-style-type: none"> • High-end brand with strong aesthetics • Available on the market before Android • Building on the success of iTunes, the legal and financial infrastructure for the App Store is already in place in various countries, thereby enhancing geographical spread (In Dec 2009 Apple paid applications were available in 77 countries, while the figure for Android was 8.) 	<ul style="list-style-type: none"> • Android can build on the success of Google • Open source platform, which enables the sharing and reuse of code • Potential for greater market share, given the variety of carriers and devices • Viewed as “morally satisfying,” compared with the more business-oriented approach of Apple
Drawbacks	<ul style="list-style-type: none"> • Limited user feedback • Limited communication with developers regarding upgrades and system amendments • \$99 fee for the SDK • Requires an Apple Mac for development • Very limited feedback with rejected apps • Degree of censorship • Inconsistency in the approval process • Seen as “too controlling.” 	<ul style="list-style-type: none"> • Limited user feedback • Smaller user base • Limited communication with developers regarding upgrades and system amendments • Does not offer the slick ecosystem that Apple can offer, whereby the Appstore, the website, and the iPhone seamlessly integrate. • Poor search facilities (seen as ironic given Google is a search engine) • The paid model has limited geographical availability (e.g., not available in Sweden)

Android developers recognize that Google is a large enterprise and their current endeavors relate to “hedging their bets” in anticipation of an increasing variety of Android devices and carriers. In this respect, the platform is used pragmatically in the hope of reaping benefits in the future, while working with an open source platform. As regards developing for multiple platforms, most of our participants tended to adopt an “either-or” approach, simply because this optimized their use of time and specialization. However, for those developers operating in a business-to-business environment, developing applications that are sponsored by an outside company, then multiple platforms are used in order to expand reach to their target audience.

Analysis of the How of Mobile Application Development

The respondents were mainly developing applications by themselves or in a small group within a company. If development was carried out in teams, they tend to be co-located within the same firm, as opposed to distributed. Working either individually or as part of a small team required versatility on the part of many of the developers and meant that many were involved in the totality of the process. This contrasts with trends in systems development that veer toward mass customization with fragmentation of the process and a lessening of control by individual developers [Quintas, 1994]. Mobile developers not only focus on software coding, graphics, interaction design, and animations, but also idea generation and customer care activities. Here is a detailed example of the development process, which is reflective of many of the practices we identified from our data analysis:

[With iPhone] the whole coding and iterating time takes a really, really long time. With that in mind we have to make sure that our products are pretty much perfect before we start coding them. What we tend to do is,



we are working in notebooks, we sketch the applications, and if there is something that we are not familiar with we will then create a series of animations that we then show users and they can help tell us whether or not the sequence of the user interface is correct, how they are expecting it to be used, normal user experience stuff. Once we are happy with that ... then we will start coding it. It would be kind of a rough version of the app to have the core functionality. This is usually in a process where we use existing libraries that we have already coded. We produce things quite roughly that are just barely functional and have a lot of errors, and then once the interface is set in stone and looks really good we will then simultaneously improve the aesthetics as well as improving the actual software behind it to the point where we are pretty happy. We then test it and test it and fix it and test it and fix it and test it until we can't find any problems anymore, and then we release it. We don't really do much in the way of serious unit testing; it's just too time-consuming for the iPhone. Once we think we are happy, we push it through the App Store and then 99 percent of the users will be happy. One percent will call us and tell us that something doesn't work, and if it makes good business sense we will then fix that problem and release another version. We keep doing that until it doesn't have any problems anymore or until it doesn't make any sense to work on it anymore.

iPhone developer, UK

Centering on the technological complexity of application development, most of the participants described the relative ease with which they became proficient, although this usually required a substantial commitment of their own time and resources. Some participants were able to reuse their expertise and many agreed that the process of mobile app development was similar to Web development. However, the resources impose constraints: "... you have more limited resources on a mobile and may need to think more about the design and development" (multi-platform developer, Sweden).

One developer explained how he was hoping that his applications would be of such a high standard that firms would look to associate their brand with it and provide sponsorship, thereby generating income:

My strategies with regard to applications that I am developing now for sale in a few weeks time are twofold. Firstly, I am going to be looking for sponsorship for them. My preference would be to find a company who would basically pay me to have their brand associated with that application. I am not stuck on that idea, so if no company steps up to sponsor the application, then I will be releasing it as a sold application. But if they do, then I will give it away and make money from the sponsorship. I am not interested in advertizing. I am making a distinction here between sponsorship—having one company sponsor me to have their brand on my product—and embedded adverts into applications. I think there is no money in embedding adverts in the applications. I am not interested in that business model. For me there are two options, I sell it to users or I charge a company to sponsor the application.

Android developer, UK

Further demands are placed on developers, since the marketing of products is vital. While application stores offer a virtual marketplace to consumers, the proliferation of applications means that it is a highly crowded arena. Developers are keen to release their app in a timely fashion and to a high standard in order to generate favorable product reviews and volume sales. Every new app is placed on the list of "Just in" applications, therefore providing several releases of the same app allows developers to improve the product and further increase visibility (since every update is listed as "Just in"). However, it is important not to release too prematurely, as it can be difficult to recover from poor ratings. Making available a free "light" version may also engender user interest in the app before the paid version is released. One developer described the difference that this creates in terms of downloads:

Free apps get more notice and more downloads than paid ones. Our apps (VoodooDoll and TwitterTime) can get around a hundred downloads a day when we charge 99 cents but get more than 2,000 downloads a day when it's free.

iPhone developer, U.S.

Many of our participants volunteered details of the strategies they adopted to maximize success, which is often adjudged according to the number of downloads, positive reviews, high ratings, chart position, and revenue. These included being the first to solve a particular problem or provide a novel application; advertizing with Google adwords and banner ads on various review sites; the linking of applications together on various Web forums so that others will review your app for you; the provision of good user support in the hope that users will go on to promote the app; using social network sites, which include blogs, creating videos of the app on Youtube, getting connected with expected users on Twitter; linking related applications together into a cluster in order to encourage consumers to purchase the set, and releasing updates on a Friday in order to remain in the "Just in" section over the weekend. Being reviewed in a high-profile distribution outlet is also advantageous since it may increase sales:

I was lucky to get reviewed in MacWorld early on (August 2008) and I was the App Store pick of the week once, so those were good traffic drivers, but you really can't count on those things.

iPhone developer, U.S.

Given the sheer volume of applications that are available, visibility is a challenge. One developer explained how he enhanced exposure:

Basically, developers need to treat iTunes as if it were PayPal, i.e. a payment/checkout mechanism. They cannot rely on just showing up in the App Store and being seen or purchased. I have a great website with a Flash demo. I advertise it with Google AdWords, banner ads, and print ads in iPhone Life Magazine, plus postings on review/user sites. I maintain an e-mail mailing list with 10,000 plus users.

iPhone developer, U.S.

IV. DISCUSSION AND CONCLUSION

The aim of this article has been to provide an overview of MADD and to situate this within the broader context that structures the practice. Our focus has been on Apple and Google, given their current market share. By providing some detail on the companies themselves and the evolution of the platforms, we offer insights into the emerging business model that is shaping the environment within which developers operate. Broadening the focus from the micro-level of developers' experiences enables us to contextualize their working practices in the wider socio-economic environment.

Applying the framework to the qualitative fieldwork allows us to sketch out how mobile application developers respond and adapt to this emerging market as they work in an industry that operates within a cycle of continuous change. The categories available have proved to be a useful tool for mapping out the mobile applications market while illustrating the attraction for developers. At the same time, populating the framework with an analysis of MADD enables fruitful comparison with OSS as provided by Feller and Fitzgerald [2000], thereby allowing clear distinctions to emerge.

For mobile applications developers, the opportunity to work on new and "leading edge" technological platforms, which demands distinct levels of creative expertise, often within the totality of the systems-development process has much appeal. However, there are a number of drawbacks, which include working in a highly competitive and increasingly crowded market and problems associated with being in a position that reacts and responds to Apple and Google rather than one of greater influence and control. The framework helps reveal the everyday working practices of IT professionals, which are far too frequently romanticized, as IT workers are portrayed as either geeks or pioneers that are driven by the desire to "crack the code" or "scratch the itch." While creative workers are seemingly in high demand, the new economy labor market is increasingly precarious [Huws, 2006], often typified by short-term contract work, long hours, the need to constantly keep ahead of latest technological developments, increased insecurity and instability, and work intensification [Evans et al., 2004; Greenbaum and Stuedahl, 2000; Tapia, 2004]. In contrast to the seductive image of pioneering innovators, many IT workers are simply striving to survive in this competitive sector.

Superficially, the mobile application market appears to represent a material change in the nature of systems development, creating low-cost consumer software that is available in abundance, easy to download, and can run on a mobile phone. However, rather than declare that these changes are of a revolutionary nature, we suggest instead that these developments represent a process of "accentuated evolution" [Kautz et al., 2007] as persistent problems and challenges continue to plague the systems-development community. These are built upon and accentuate a number of continuing trends, which are as follows:

1. The commodification of software [Quintas, 1994] that is developed "at a distance" from the end-consumer, represents a shift in focus from software processes to products. This has been taking place for some time, notably with the development of enterprise systems, as well as small scale, off-the-shelf software packages. The availability of applications for mobile devices merely continues this development.
2. Radical innovations in IT artifacts and systems have often run alongside the restructuring of the IT industry. This has changed from a sector with large, bureaucratic organizations providing clearly defined career structures (as typified in the study by Kunda [1992]) to a sector with large amounts of outsourced contract work, resulting in boundaryless, project-based and portfolio careers [Barley and Kunda, 2004]. In order to survive in the industry, many IT workers have had to adapt accordingly; part of their response includes developing innovative, low-cost products with broad consumer appeal, such as mobile applications.
3. The rise and success of IT offshoring operates as the blueprint for the growing trade in the subcontracting of systems development, and this upwards trend looks set to continue. The outsourcing of



expertise to third-party developers and firms has facilitated a change in perception of managerial thinking, generating faith in sourcing product innovation beyond the boundaries of the firm. Yet offshoring, although advantageous for many, continues to be beset by a host of problems [Oshri et al., 2009]. There is a trade-off when searching for a lower-cost solution that may involve compromising within an appropriate cultural context and regulatory framework. Turning to mobile applications, we can see that Apple and Google have managed to successfully erase many of these challenges as issues of infrastructure, connectivity and regulatory environment are determined by Apple and Google and their ability to set up online stores in national settings. Once this is established there are no limits as to how many applications can be submitted by developers and made available to download.

Many outsourcing firms are attracted to lower cost locations because labor regulations and human resource policies are comparatively lax. In the case of mobile applications developers, employment contracts are immaterial as there is no alternative other than freelancing, in the hope that revenue will be generated. Drawing on the global labor market of systems developers enables Apple and Google to leverage a highly educated and technically competent workforce that largely consists of individuals who take personal responsibility for the updating of their ICT skills. Their business model is based on the outsourcing of non-core activities whereby, as powerful high-tech firms, they retain a premier position within a satellite of distributed suppliers, while successfully outsourcing the risk. There is no need to specify a contract or deliverables, since mobile application developers readily supply huge numbers of applications to the online stores. A key problematic regularly picked up by the media concerns issues of linguistic and cultural compatibility with offshore destinations, but these are eliminated as the vast majority of developers are based in Westernized, developed economies.

The business model of MADD can more appropriately be called outsourcing of a special kind, which is more popularly known as crowdsourcing [Brabham, 2008]. While there are many examples of digital platforms that enable users to create and share resources, such as Web 2.0 or toolkits for user innovation, a key distinction here rests on the commercial element with third-party developers mediating between the platform providers and their customer base. In this respect, developers operate as part of a crowdsourced workforce as opposed to operating as a “supplier as peer producer” [cf. Remneland-Wikhamn et al., 2011]. Compared to open source, which is characterized by decentralized control of fairly homogenous knowledge sources, MADD is characterized by centralized control of loosely-coupled individuals and small firms, each offering heterogeneous knowledge resources [Ghazawneh and Henfridsson, 2010].

Some may consider that a limitation of this study is that it does not allow us to determine how broadly the findings apply and a survey may be useful in this respect. Our study was intended to generate some initial insights into this under-researched area which could be refined and expanded upon in future work. The framework that has been used in this article has been useful for outlining this emerging area, and no doubt the application of robust theory would illuminate other aspects which we have chosen not to focus on. We would welcome more research, particularly of a longitudinal nature, since that could allow one to follow the life histories or career narratives of individual developers, or to gain insights into how particular firms operate. This will enable a more sophisticated understanding of an increasingly relevant area of systems development.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the article on the Web, can gain direct access to these linked references. Readers are warned, however, that:

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