Abstract: This article seeks to contribute to the development of a relationship between digital game studies and science and technology studies by studying the design and development of computer games at three leading UK studios in the light of what MacKenzie refers to “the material production of virtuality” (MacKenzie 2007). The article examines the common ground in treatment of ‘the virtual’ and ‘virtuality’ in science and technology studies and studies of material culture and the importance placed in the relationship between ‘virtuality’ and ‘materiality’ as “a dialectical process of imagination followed by its realisation” (Miller 2005) for the “expressions of immaterial ideals through material forms” (Miller 2005). The article explores the concept of ‘explication’ as a crucial part of this dialectical process through which previously unmapped and unformatted aspects of the world are articulated to the formalisms on which social life depends and through which certain of its features become gradually more explicit and ultimately knowable socially.
Introduction

By the “material production of virtuality” MacKenzie refers to how abstract or virtual entities are brought into being, illustrating in the process how “virtuality is a material effect, indeed an elaborate, sophisticated, and expensive one” (MacKenzie 2007) and how “immateriality can only be expressed through materiality” (Miller 2005). Through the empirical account presented, the article shows the extent of material effort that must go into the production of the virtual worlds of computer games, and how it is through the confrontation of the proposed virtual world of the game designers with the materiality of its production that “a privileged trajectory is built, out of an infinite number of possibilities” (Akrich 1992).

The article draws on an empirical study of three leading UK computer games developers. Through a combination of interviews, observations, and the study of shared artefacts involved in the development of computer games, the research aims to capture, through the tracing of the interactions of the developers both with these objects and with one another, an in-depth picture of the way the developers studied produce virtuality through the ordering and assembling of heterogeneous entities.

Focusing in particular on the practices and trials through which non-explicit or under-determined features of the computer game being developed are rendered explicit and knowable during the development process, the article seeks to contribute to the development of the nascent concept of ‘explication’, described by Muniesa as the “radically inventive work” that goes into making something explicit, not in the sense of “clarifying or implementing something that is already prefigured as a potential reality, but rather about putting that thing to the test of variable, often conflicting and unanticipated forms of actualization” (Muniesa 2010).

The article seeks to show how this concept can not only be successfully deployed analytically in an empirical research setting such as the digital games development, but also how, out of this deployment, the concept itself can be extended, illuminated, and further shaped.

The relationship between ‘virtuality’ and ‘materiality’

Approaches to ‘virtuality’ and the relationship between ‘virtuality’, ‘materiality and ‘immateriality’ in science and technology studies have a degree of common ground with the growing field of studies of material culture (Miller 1998). A key premise shared between the two fields of study is, as Daniel Miller writes drawing on studies that range from religion and theology to economics and finance, that “the immaterial is not easily separated from the material”, with humans defined, “to an extraordinary degree, by their expressions of immaterial ideals through material forms” (Miller 2005).

Both MacKenzie and Miller also point out, that ‘materiality’ should not be reduced to ‘physicality’ (Miller 2005; MacKenzie 2007). Of course, it involves “physical objects, technological systems and human bodies”, but also “the legal systems, cultures, procedures, beliefs and social relations that objects and bodies express, make possible, are shaped by, and are enmeshed in” (MacKenzie 2007). Even the most abstract of

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things (e.g. financial derivatives in the case of MacKenzie) are “particular material configurations”, and the ‘material production of virtuality’ is about “the way in which those configurations are brought into being, shaped and sustained” (MacKenzie 2007).

For Miller, the relationship between ‘materiality’ and ‘immateriality’ and how immaterial ideas are expressed and sustained through material forms are key locations for examination and empirical study (Miller 2005). For Miller, it is through “a dialectical process of imagination followed by its realisation” (Miller 2005) that the production of ‘virtuality’, through – for example – the financial derivatives studied by MacKenzie, is achieved (MacKenzie 2007).

Financial derivatives just as much as digital games are invented, both being the result of “conscious, deliberate processes of design” (MacKenzie 2007) through which an imagined world – or configuration – in which the actual materiality of the existing world is altered or even suspended is brought into being. By drawing attention to how the comparison between innovation in finance and in physical technology can be “analytically productive” despite key differences between the two (MacKenzie 2007), MacKenzie hints at the importance of what Miller refers to as the “dialectical process of imagination followed by its realisation” (Miller 2005) to processes of design and innovation in general.

Considered in this way, despite obvious differences, both financial derivatives and digital games can be seen as what Latour calls “industries and technologies of imagination” and in relation to which Latour explores the topic of ‘virtuality’ through a discussion of the proliferation of digital virtual worlds in relation to past technologies of imagination, such as novels (Latour 2007). To illustrate this, Latour writes:

“It would be very odd to say, when thinking of the young hero of Marcel Proust’s A la recherche du temps perdu, who spends whole days utterly absorbed in the fictional landscapes painted by his favourite novelists, that he resided in a ‘real’ world, while a youngster of today who buys rather expensive equipment to play with buddies on the other side of the planet through wireless and satellite connections would be said to be living in a ‘virtual’ landscape”.¹

For Latour, precisely because of the huge effort needed to bring digital virtual worlds into being compared to the virtual worlds of a novel, “the adjective ‘virtual’ may be greatly misleading” (Latour 2007). The 21st-century counterparts of Proust’s narrator “have to embed their imagination in so much hardware and software paraphernalia that they clearly end up in a more real, more connected, more technical world” (Latour 2007). For Latour, one ‘technology of the imagination’, “that of the printed book” has been “partially replaced by a vastly more complicated and concentrated entertainment industry” (Latour 2007) that is in a position, both in terms of know-how and financial resources, to undertake the complex and complicated task of the ‘material production of virtuality’ necessary for these new worlds to be brought into


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being. “Imagination no longer comes as cheaply as it did in the past”, because “the slightest move in the virtual landscape has to be paid for in lines of code” (Latour 2007).

In these different if somewhat convergent views of ‘the virtual’, ‘virtuality’, ‘materiality’ and ‘immateriality’, one common theme is the importance of the relationship between the material and the immaterial, the ‘actual’ and the ‘virtual’, the ‘concrete’ or ‘tangible’ and the ‘abstract’.

Miller, focusing on Hagel’s *Phenomenology of the Spirit* (Hegel 1977), draws attention to the way that for Hagel there is “no fundamental separation between humanity and materiality”, but rather a “fundamental process of objectification” through which “everything that we are and do arises out of the reflection upon ourselves given by the mirror image of the process by which we create form and are created by this same process” (Miller 2005). It is only through this creating of form that we can “comprehend anything, including ourselves” (Miller 2005). It is subsequently as such forms develop in sophistication, that “we are able to see more complex possibilities for ourselves in them” (Miller 2005). Miller illustrates this, as follows:

“As we create law, we understand ourselves as people with rights and limitations. As we create art we may see ourselves as a genius, or as unsophisticated. We cannot know who we are, or become what we are, except by looking in a material mirror, which is the historical world created by those who lived before us and confronts us as material culture, and that continues to evolve through us.”

For MacKenzie also, the relationship between the ‘abstract’ and the ‘material’, which in relation to the design of financial derivatives Mackenzie deals with through the notion of “facticity”, is a key aspect of the ‘material production of virtuality’ (MacKenzie 2007). The notion of “facticity” is employed by MacKenzie to refer to the way the assets or rates underlying derivatives relate to those derivatives. “Whether it be a price, an index level, an interest rate or a measurement of weather, longevity or other entity”, writes MacKenzie, there “must be a fact that underlies the derivative and that is believed by all those engaged in the trading of that derivative to genuinely express conditions in the market or process underlying the derivative” (MacKenzie 2007).

While not developed for the purpose of dealing with questions of ‘virtuality’ and ‘immateriality’, Latour’s concept of “plasma” (Latour 2005) chimes with these important points. Latour uses “plasma” to refer to all that is outside the narrow channels of existing social relations and the formalisms they depend on. Because these formalisms can never be “complete”, it is always necessary to “add something that is coming from elsewhere and which by definition, is not itself formal” (Latour 2005). The ‘material production of virtuality’ could be considered as one such conduit through which the imagined or imaginary – seen as part of this vast unknown

hinterland – is made knowable, socialised, formatted, and given shape in order to be articulated with the narrow channels of the social.

Latour summarises the notion of “plasma” as “that which is not formatted, not yet measured, not yet socialised, not yet engaged in metrological chains, and not yet covered, surveyed, mobilized, or subjectified” (Latour 2005), going on to add:

“It is not hidden, simply unknown. It resembles a vast hinterland providing the resources for every single course of action to be fulfilled, much like the countryside for an urban dweller, much like the missing masses for a cosmologist trying to balance out the weight of the universe.”

It is out of this process of attempting to articulate parts of this unmapped and unformatted hinterland to the formalisms on which social life largely depends that certain of its features become gradually more explicit and ultimately knowable socially.

Latour points to the work of Emmanuel Diddier on the compilation of statistics at the time of the New Deal in the USA (Didier 2001) as an example of “plasma” being turned into numbers (Latour 2005). This, in turn, has significant common ground with the notion of “explication” proposed by Muniesa and described as the “radically inventive work” that goes into making something explicit, not in the sense of clarifying or implementing something that is already prefigured as a potential reality, but rather about putting that thing to the test of variable, often conflicting and unanticipated forms of actualization” (Muniesa 2010).

This notion of ‘explication’ is not far from Miller’s position regarding the importance of processes of “objectification” and the centrality to what “we are and do” of the processes by which we create form (Miller 2005).

A key premise that this article seeks to develop is that the imagined and/or imaginary of virtual worlds – in this case the virtual worlds of digital games – is as much part of this vast unknown hinterland that Latour calls “plasma” as unknown aspects of the physical world. It is then through attempts to articulate this with the materiality of the narrow channels of existing social relations and the formalisms they depend on that parts of this hinterland are rendered gradually more explicit as they become part of “tests of variable or even conflicting and unanticipated forms of actualization” (Muniesa 2010).

**Research approach**

The approach taken for the empirical investigation sought to pay particular attention to the importance, highlighted by Suchman, of analysing “the dynamic structuring of peoples’ interactions with each other and with their material environments” which contributes to “developing understanding of the social and material organization of skilled practice within complex, technology-intensive worksites” and allows one to “see how a work group distributed in space is tied together through architectural, technological, and interactional resources, as well as the obstacles that such a group must face” (Suchman 1997).

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Objects and the material aspects of the collaboration involved in the development of computer games formed a central part of this study of how new digital ‘virtual’ worlds were developed. This helped overcome the difficulties of making tacit knowledge explicit verbally (Polanyi 1967) and of knowing “more than we can tell” (Carlile 2002). As Carlile suggests, the research gave a central importance to studying “individuals in practice … focusing on the objects they work with and the ends that they pursue”.

The article draws on studies of three leading UK computer games design and development studios the aim of which was to capture an in-depth understanding of the way in which the digital games developers studied produce the ‘virtuality’ of game worlds by confronting intangible and difficult to represent aesthetic and experiential features of these games with the materiality of both the game production process and the playing of the games.

**Research Sites**

**GamesDevCo**
The first study site was GamesDevCo, a pseudonym for a UK-based games development company. Since its foundation in 1990 GamesDevCo has grown into a leading independent multi-platform developer employing around 250 people and comprising of five distinct divisions: family games; mature titles; serious games; downloadable games; and games technology. The company develops games under both its own brands as well as on behalf of external publishers and intellectual property rights holders.

**PetName**
The second site was PetName, a pseudonym for a leading UK-based games development company that since its formation in 1997 has developed a series of commercially successful, critically-acclaimed, and award-winning strategy, action role-playing, and simulation games. The company develops its own titles, almost exclusively for the Xbox console, with dedicated teams moving from one release of the title to work on the next release in quick succession, aiming to have a higher output of releases than has been the case with games studios so far.

**Dredd**
The third case study was conducted at Dredd. Dredd is a pseudonym for a UK-based computer games developer that since its establishment in 1992 has, through the acquisition of other UK studios, become one of the largest UK computer games developers; what has started to be referred to in the UK games development sector as a “superstudio”. The company produces games both under its own brand and for third-party clients and has enjoyed significant commercial success. It is now a multi-platform and multi-genre developer operating out of four different locations around the UK.

**Evidence Collection**
The research deployed a combination of in-depth interviews and observations at the three sites, accessing key shared objects involved in the development of the computer
games developed there, identifying key translations and associations that need to be put in place during the development of the games, and accounting for how these were performed in practice by the humans and objects involved.

Formal interviews that were more wide-ranging and lasted longer (between 1h 40min to 3h) were recorded and transcribed. While a set of headline themes relating to how a game moves from conceptualisation to realisation and what key shared objects were involved in the process informed the questioning, no specific list of questions was used during the interviewing.

Informal interviews were used for much more specific questions relating to key aspects of the development process that emerged during the observations. These typically lasted between 10 and 20 minutes and were usually recorded in hand-written notes rather than through voice recordings in order to capture ‘on the spot’ and at that moment an explanation from those involved in the activity at that time of a key aspect of the collaboration that was deemed of interest during the observational work.

The observational material was recorded primarily in note form continuously during the time at the studios, usually contemporaneously (or very soon after a certain event or encounter of interest). Field notes were supplemented by: sketches drawn by the developers as they explained something, either to the researcher or to each other; print-outs of key documents used in the development process; screen grabs of computer applications and displays; some photographs taken at one of the studios during observations; and sketches done by the researcher.

**Analysis**

For the purpose of this article, the empirical material assembled has been analysed in relation to how what Miller refers to as “a dialectical process of imagination followed by its realisation” (Miller 2005) was performed by the computer games developers studied.

In order to aid this analysis, interview transcripts and observation notes were imported into nVivo – a qualitative data analysis software – which was used primarily as a tool for organizing and structuring the data. Interview transcripts and observation notes were coded in relation to the occurrence of such processes identified across all three sites.

From the empirical material thus identified as relevant, accounts and descriptions of such processes were compiled and which are presented in the following section.

**Computer games development and the “material production of virtuality”**

For a computer game to be realised, a whole set of objects – referred to as “assets” by the developers – need to be brought together and relations among these objects established in a particular way. These “assets”, include digital artwork for entities – both active and passive – that inhabit the game, 3D models of artefacts and buildings, digital artwork relating to the setting within which the game takes place, maps of levels and locations, animation sequences, artificial intelligence (AI) algorithms for entities not controlled by the player, visual textures, lighting and shading, special

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effects, sounds, text and spoken dialogues, music, and many more depending on the game, its genre, and its complexity.

The sequence of processes that “takes assets from their source form (usually the direct output of whatever package the artist created them in) to the final data that can be burned on to a disc or cartridge to form part of the finished game”, is what is referred to among the developers as the “asset pipeline” (Carter 2004). It was a central common preoccupation of the teams encountered, especially among members in more senior roles, to ensure this “pipeline” was well coordinated and assets were at the right place at the right time and in the right form, both in relation to each other, but also in terms of the demands of the computer code at the centre of the game known as the ‘game engine’.

Much formal coordination was involved in managing this production process and ensuring that the flow of “assets” along the “asset pipeline” is unproblematic and seamless.

While across all the three sites studied a great deal of effort and attention was directed towards the organisation and management of this production process – both in terms of time (meeting of deadlines), but also in terms of reducing the likelihood of the failure of a project and ensuring as unproblematic as possible delivery of the final product – the research also found a great deal of effort being directed towards capturing and developing under-determined emergent and difficult to represent sensory, aesthetic, and experiential features of the games.

“Not enough to be on budget and on time”

There was unanimous agreement among informers – even from some of the most hard-nosed and completion-driven executives – that there was little point in developing a game that was on-budget and on-time, but no one wanted to play. While the planning and scheduling of the known aspects of the games being developed were seen as crucial across all three sites and a great deal of effort and resources were directed towards managing these activities, there was also a realisation that getting that right was not enough, in itself, for the success of a game. A senior producer at Dredd, talking about this in the context of the processes involved in assembling a project plan, commented characteristically:

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5 The game engine is a software system for the creation and development of video games. The functionality provided typically by a game engine includes: a rendering engine for 2D and/or 3D graphics that generates, by means of computer programs, images from a mathematical description of objects based on geometry, viewpoint, texture, lighting, and shading information; a physics engine dealing with collision detection and responses using algorithms that check for the intersection of two given mathematically represented solid objects simulating what happens once a collision is detected without which characters would go through walls and other obstacles; sound processing; scripting control for other software applications in the game; animation; artificial intelligence; networking; streaming; memory management; threading; and scene graphs that arrange the logical and spatial representation of a graphical scene. Due to the high cost of developing these functionalities from scratch, game development studios in large part reuse the game engine for a number of different games, often improving functionality and performance incrementally.

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“I’ve got all this paper interaction going on. I’ve got strike teams there. I’ve got people getting deadlines. I’ve got people defining their deadlines to me. I’ve got a waterfall schedule. I’ve got an idea of how many people it’s going to take to make the game. I’ve got an idea of how risky and how complex it’s going to be. … [But], it’s not just all about planning. These guys make tangible assets, [but also], they create an experience on a screen; and that’s what it’s all about. I provide a beautiful plan, but that’s not going to mean anything to Joe Schmoe, who goes out and buys a game off the shelves.”

It was seen as crucial to the successful development of these under-determined features of the game by the developers encountered that a clear shared understanding of intangible and difficult to represent aspects of the game such as its “feel”, “mood”, or “atmosphere” – what they referred to as “the vision” for the game – permeated the work of the development teams.

**Materialising underdetermined features**

The development teams across all three of the digital games studios studied had similar and highly material techniques for rendering explicit these difficult to surface and capture aspects and features of the games with an important role played by concept art and what they called “external references”.

External references could be movies, a book, or in some cases, another game. In the case, for example, of one of the studios where work on a region in the gameworld under development was taking place in which factories and industries with terrible working and living conditions – including child labour – were to be found, Friedrich Engels’ book *The Condition of the Working Class in England* (Engels and McLellan 2009) describing conditions in Manchester at the time of the industrial revolution was found to be especially useful by both the team working on that region of the game and the development team overall.

Things such as movies were found to be particularly important in terms of surfacing and sharing among the teams studied a common understanding of what was intended regarding the “emotion” or visual style of the game. This shared understanding would – in turn – coordinate the realisation of these difficult to represent aspects of the game by different individuals and groups as they built into the assets they contributed their interpretation of this understanding, giving it gradually form and concrete expression.

The importance of external references for conveying to the individuals involved a particular “feel”, “mood”, or “atmosphere” for a level, quest, or scene, is illustrated in the passage below, again from GamesDevCo, but which was also confirmed from viewing the pages from the “game design document” of one of the games at PetName in which copious visual and other external references were provided:

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6 The "game design document" (GDD) is composed of many sub-documents and is stored on – and available from – the shared servers of the development teams. It is also frequently materialised in the form of physical print-outs – usually of only certain of its location or quest-specific constituent sub-documents at a time – for use in meetings. The GDDs specify many of the features of the game under development such as the levels the game will have; what these levels will be like; the script – including dialogues and decision paths – of the game and how that relates the different levels to each other; who the characters are; what their role in the game is; where they can appear; how they can encounter each

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“With everything we have created, even if it is ‘true to original’ there is always a movie, or a book in some cases, or another game possibly, that have done something similar or have done something diametrically opposite that we can say: ‘this is really what we don’t want, we really don’t want this vision’. Or, ‘what I am trying to get to is this’, or ‘here is a movie’. Everyone watches the movie and they then hopefully understand what you mean about the emotion of the game or the visual style of the game or whatever it might be. … Using those … references, to say, 'right we really want this', then … people come up with ideas and come up with visual styles [and] that's how [the vision] works; it kind of trickles down.”

At PetName there was an interest more specific to this studio regarding the use of video in relation to rendering explicit features that were either not fully specified or specifiable or even not encountered previously. One example that was shown during the research at this site was of the video of a wrestler from which the prototype for a confined combat animation sequence was developed. Another concerned developing scenes and animations for the sword fighting in the game. The video itself was of lessons that the animations team attended with a professional swordsman in which, in addition to the direct feel and understanding for the movements and techniques that the development team acquired from the session, also enabled the animators to take the video “and pause it right down” in order to analyse and translate the moves into 3D computer animations.

“This is where we took some guys off-site and [sent] them [to a] real-life sword master … who sword fights and works in the film industry”, explained the development manager of the team. The sword master helped both animate the scenes through performing the moves and also contributing to the design of the sword fighting scenes in the game. Very importantly, however, he also showed the developers “how to fight with a sword so they knew ahead of time that when they came to animate and design [a sword fight]”, what the “real-life experience of sword fighting” was like. And this was as important to the programmers as to the artists on the animation team, because, for example it was important for them to have a ‘feel’ for the weight and mechanics of a real sword.

Drawings, either on their own or within the context of other shared project documents such as the “concept book”7 and “games design document”8, were found to have a crucial role in making accessible to the members of the development teams many of the aspects of the games that are intangible and difficult to represent verbally.

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7 An important material nexus for the early-stage conceptualisation development of a game. Sometimes also referred to as the “concept document”, these documents included text that described the game and its features, the thinking behind it as well as visual representations of the main characters of the game accompanied by what can be described as imaginary biographies for them outlining their roles in the game and what they could do. The documents often – though not always – also included outline budgets and cost projections for the proposed game.

8 See footnote 7 for a description.

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A central role in such a process was played by what the developers referred to as “concept art”. It is produced by specialist artists whose role it is to translate into drawings – and even sometimes models – some of the central aesthetic elements of the game concept, as the lead concept artist at PetName explained:

“Concept art should take a basic idea that you have been given, and then imbue it with all the atmosphere possible”.

The central importance of concept art in terms of rendering explicit the under-defined features of a computer game is illustrated by the following comment from an executive producer at PetName:

“The more ways that we can do that – communicate exactly what [we] want [and] for everyone to get and understand it – [the better]. It is like the Holy Grail; because everyone understands differently. If you go visual that helps immensely. … We have fulltime concept artists. We use a [concept artist] right now who is drawing-up all our levels that will educate far more than any 20-page document about how that level is going to be.”

Drawing and concept art were seen in a similar light at the other two studios. The following comment captures vividly their use at GamesDevCo:

“We try and draw a huge amount of stuff during the project because the cheapest way of getting any visualisations is by drawing. The [art specialists] are trained to draw extremely fast as well, so we spend a lot of time drawing out the environments, drawing out some of the character moves in regards to the animations cycles, drawing out all the characters' weapons, individually style anything else we need, sometimes just drawing with regards to diagrammatic things, saying: 'I want this character to move like this'; or, 'here is one of the character moves and I want it to look dynamic in this kind of way'; or whatever. Some quite functional things like that. So, when we hit production we've got a huge amount of material there.”

Although vitally important in terms of capturing and making available, not only across the development team but also to external collaborators and backers, the intended “feel” of the game, concept art was also important in terms of the practical work of translating those intangibles into the concrete assets for the game, as the following from the development manager at PetName regarding the importance of the concept artist shows:

“We use concept [art] in huge amounts. We have one guy whose only job in the world is to sit there with a drawing pad and knock out lots and lots of concept artwork of creatures, characters and costumes. … Sometimes [it is for] the internal team, sometimes the outsourcing teams. When someone says: ‘I’ve got this task on my schedule to go and build the bucket’, there’s concept [art] along with it to make sure that the style is consistent; that he is not thinking of a silver bucket, rather than a wooden bucket; that everyone understands what he is to build. Alongside that you [might] have

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in the databases and the artbase a prototype bucket, or what is set-up. [The concept artist might have also] made a model as practice. This is a bucket; here’s the description, and here’s how many [there] are supposed to be. Here’s what your [technical] budget is. So there’s no room for error there; they can’t get it wrong.”

**Explication through formalisation**

Despite the central importance of visual and other non word-based references in terms of making knowable across the team many of the non-explicit or difficult to represent features, it was stressed that it was not instead of, but through a combination with more formal word-based approaches that these worked best. “If we can use pictures … we will, but that doesn’t mean there can be no words”, emphasised an executive producer at PetName. “There still need to be technical design documents, which [contain] very careful thinking about the structure and masks and architecture of those features and programming points; there still need to be design documents, stories and dialogue written out for these kinds of notes.”

With “[subjective] features its going to go a bit crazy”, explained a producer at Dredd. “For features you want stakeholders, you need reviews, you need sign offs”, he continued highlighting some of the key stages of such review and iteration processes that were encountered at all of the three sites studied. Within a particular project these iteration and review processes could be either formalised, as in the case of regular and highly structured milestone review meetings, or more ad hoc, relating to collaboration among certain sub-teams on much more specific and discrete elements of the game.

There was general agreement among all the participants across the sites in this research that there was no substitute for seeing how assets being developed would behave within the ambit of the actual game itself, even if that was a very minimal and underdeveloped version of the expected final polished outcome. In addition, during the observational work undertaken, it was clear that a great deal of time during the working day was spent in meetings of varying degrees of formality and scale of participation – ranging from three or four people around a computer terminal to entire teams in a meeting room – examining in some detail the impact of alterations to assets on the game and whether the desired result was achieved by their incorporation into the game.

At GamesDevCo, the importance of the review and iteration process was described in the following way:

>“When work starts getting developed, like character scenarios or storylines or character designs or weapons, we can look at those – the leads look at those – and go: 'this really doesn't fit ...can we revise it', or ‘do we have to junk it, or what?’ By going through that process and learning, and by saying: 'yes, I get it, current design doesn't fit because it's got the wrong kind of proportions’, or, ‘the wrong colour skin’, or whatever it might be, and then learn from that and [go], 'OK, sorry about that I didn't realise, I'll revise and redo'. Then next time [it] will be closer and closer until at some point they will hit it; and that is how we go forward. It is important, that kind of iteration and going through the work around and around, approving stuff and going forwards.”

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Milestone review meetings were the most extensive and formally organised and structured of these review arrangements. By being the venue in which the human and material entities involved in the development of the game were brought together and confronted with what has been done so far and what was still needed to complete the game, these meetings were a crucial mechanism through which the boundary between what is know, explicit, and formally represented and what is missing or needs to be further determined and rendered explicit in a way that allows the existing representational practices of the developers to deal with it, is dynamically defined, meeting-by-meeting.

A great deal of insight regarding the way milestone review meetings were performed, the practices involved, and the central role the meetings played in managing the emergence involved in the development process was gained from being able to observe an entire meeting lasting the whole working day at PetName.

Review meetings at PetName took place every six weeks and in addition to checking the delivery by the teams of the outputs agreed for that period, they also provided a forum for a detailed “show and tell” in which the teams would also talk more generally about what they had been working on in the past six weeks and what they were planning to work on over the subsequent six weeks to the next meeting.

The teams participating in the meeting would use their own game console – sometimes more than one – with those presenting plugging in their console to the audio visual system of the meeting room and demonstrating the objects of the task being assessed and reviewed as they were in the game. Central to the performance of the meeting were the printouts of the milestone schedule that participants collected as they came into the room.

In the table the 1st column described the High Level Goals of the project which were divided into key work areas such as “Engine”, “Gameplay”, “Characters & Creatures”, “Regions” and so on and which were then subdivided into smaller tasks and outputs. These had then been allocated to individuals and teams, identified in two separate subsequent columns, with the concrete deliverables expected described in the column after. A column after that then allowed for comments regarding the work and the outcomes to be added by the teams or individuals involved. This was also where problems being encountered could be inserted and described. Finally there were columns that related to signing-off with fields for the final “owner” of the deliverable and comments and notes on that particular sign-off.

In addition to checking progress and managing interdependencies, a key purpose of the review meeting was for everyone on the development team to become familiarised with the layout and features of existing and new locations and levels in the game. This had an important function as it would enable participants to understand what kind of inputs might be required from them for the latter. This was not a one-way explanation, however. During the “walk through” of existing and still being worked on levels and quests, quite a lot of interaction between the level designers and all the others in the room took place, with intervening, commenting, and the asking questions taking place on a continuous basis. This way, it was possible, not only for the thinking of the designers to be elucidated and shared with the others, but also for the response
of those outside the design team to be elicited, articulated, and also recorded in the
notes being taken by the senior members of the production team and if necessary
added from there to the project documentation and schedule. Through this kind of
interaction it was possible to ‘capture’ and represent through the more formal
coordination mechanisms and devices, emergent features of the game.

From small issues of unforeseen dependencies to large questions concerning how a
particular feature relates to the overall “vision” or logic of the game or a particular
aimed-for playing experience for the end-user, the milestone review provided the
forum for team-wide debate, discussion, argument, clarification, agreement, and the
collective entering into commitments.

Combined with the fixedness of the milestone schedule and accompanying temporal
regularity of the review process, milestone reviews were found to be crucial in terms
both of coordination but also in terms of rendering explicit issues that may have not
been resolved or even considered previously. Central to this was the way that in the
milestone review meetings the value and worth to the game of particular features was
debated collectively and decisions regarding whether to persist with them through
further investments of resources and time or whether they should be jettisoned were
agreed upon.

**Discussion**

During the empirical research at the three games development studios studied –
especially the observational work – it was possible to see at first hand how
underdetermined features of the games under development were gradually ‘filled-in’
and rendered explicit during the unfolding of the projects.

The shared understanding referred to as “the vision”, evolved and became more
explicit and stable as the game development process unfolded and it started to find
increasingly concrete expression in the assets and early stages of the game. As this
progressive realisation of the “feel”, “mood”, or “atmosphere” of the game took place,
the stronger the effect this shared understanding would have in terms of informing the
work of the developers regarding the aesthetic and experiential features of the game.
It was through the progressive formalisation of the descriptions of these features and
their incorporation into the temporal, sequential, and relational ordering of the formal
coordination mechanisms and devices of the studios that they took shape and
substance. As has been described, iterations and revisions were central to how
emergent and previously underdetermined features were captured, formalised, and
made available back to the development teams.

Despite the central importance of visual and other non word-based references in terms
of making knowable across the team many of the non-explicit or difficult to represent
features, it was stressed that it was not instead of, but through a combination with
more formal approaches that these worked best. As the PetName producer underlined,
“there still need to be technical design documents, which are very careful thinking
about the structure and masks and architecture of those features and programming
points; there still need to be design documents, stories and dialogue written out for
these kinds of notes.”

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for permission before citation or circulation.
It was through the progressive formalisation of the descriptions of these aesthetic and experiential features that they took shape and substance and gradually became collectively knowable and explicit.

While there is a widely-held view that endeavours involving imagination, creativity, and aesthetics are the domain of particular gifted individuals where “the sky – or imagination – is the limit” to what can be accomplished (Hargadon and Bechky 2006), the game development processes studied showed how, while there is a wide spectrum of features that could become actualised, it is through the confrontation with a number of technological and other materialities that are resolved through the kind of interrogations and trials described in the processes of reviewing and iteration presented, that a certain version of ‘virtuality’ rather than another starts to take a durable and stable form. It is through the resolution of such trials of explication that, in the words of Akrich, “a privileged trajectory is built, out of an infinite number of possibilities” (Akrich 1992).

The need for computational and algorithmic certainty demanded by the digital electronic technologies through which the games are played render explicit facets of an imaginary world that initially may have been obscure or treated elliptically. In the initial word and drawing-based representation of the game under development such as the ‘concept book’, many more ‘details’ can remain ‘pending’, giving more flexibility to the framing of interactions both among the developers but also in relation to the other heterogeneous entities that will make up the game. This cannot be the case, at least to the same degree, when these word and drawing-based worlds have to be translated into computer code. It is not possible to include a line in an artificial intelligence algorithm for a non-playable character that says: “if X then, we will see, someone will give a call to the designers”. The algorithmic and computational certainty demanded by the game engine that will convert all the elements that make up the computer game into the final binary code that will run on a computer or console on which the game will be played, results in the surfacing of problems that earlier in the development process may have not need to be dealt with. As a result, they would therefore have not been taken into account in the design of the game, being rendered explicit and visible by virtue of the need for concrete and unambiguous responses from all entities involved. In this way, through the design and development of the new game, the stakes of the various human and non-human actants become visible and attain a concrete shape. The game developers, in effect, set in motion trials that act as tests of explicitness for the entities with which the game engine software must interface. It is through this process that previously implicit or obscure features are rendered explicit through the development process itself and not through some linear and discrete sequence of design and development.

This demand for explicitness does not only concern technical issues, however. While an elliptical “vision” for the game can be “to produce the Saving Private Ryan of computer games”, allowing for different – if to some extent concurrent – interpretations and configurations to be imagined by the developers, a working computer game running on a computer or console demands precise and unambiguous responses from the people, institutions, devices, and systems around it.

Through the resolution of these kind of trials encountered in the research, both the new game itself and the external structures and entities it comes into contact with are
put to the test. In the process, important questions that must be resolved and assumptions that have been built into the rival views of the world inscribed into the sociotechnical entities that have thus come into contact, are rendered explicit and contestable. Before such trials, these questions lacked a concrete form, in the same way we might know there is a certain law, but not knowing what this law does in a specific case until that specific case is somehow triggered.

Conclusion

The material arrangements being put in place for the realisation of a new digital game virtual world become a concrete interrogation of the actual world – both conceptual and material – surrounding the project. Points of interface between the emerging game and other sociotechnical systems and networks become a nexus of actions, questions and responses on the part of a range of agencies required to respond to the concrete demands and implications of the needs of the new game to interface with the world around it. While the emerging material fact, rather than abstract concept, of a functioning computer game demands responses from the world that surrounds it, yet the course of the responses, both on the part of the designers of the game and the other external entities this interfacing has brought it into contact with, cannot always be predicted (Barry 2002). The necessity of a response is created even if the response itself cannot be pre-determined (Barry 2002).

As a digital game proceeds from an idea/concept, a tentative or untested articulation to the world around it that contains certain assumptions about this world is proposed. If successful, a certain performativity is achieved for these ideas/concepts (MacKenzie, Muniesa et al. 2007). They become part of the world; they gain substance. Through this work of articulation, a new aspect of the world is unfolded and rendered explicit. People and things are brought into the performance. A chain of reference is established from concept to world and back. The people who buy and play the computer game, just as those who buy and trade a financial derivative, start to be part of the new worlds these ideas/concepts propose; participate in its performance; and engage (whether critically or acceptingly or both) with the assumptions built into it. In the process, a new aspect of reality is rendered explicit and in concrete form.

As Latour writes in regard to technologies in general, they are not just means to and end but “incite around them that whirlwind of new worlds” (Latour 2002). It is through the processes and trials of explication involved in attempts to articulate these new worlds with the materiality of the narrow channels of existing social relations and the formalisms they depend on that parts of this unformatted hinterland are rendered gradually more explicit as parts of “tests of variable or even conflicting and unanticipated forms of actualization” (Muniesa 2010). And this holds as much for the new virtual worlds of digital games, as for those of financial derivatives, or innovative physical technologies.

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References


