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GAME DEVELOPMENT RESEARCH

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1. Introduction

Digital games have become a ubiquitous part of our society. In many countries, game development is a substantial and important industry. Furthermore, academic institutions provide programmes aimed at preparing students for careers in game development. Such programmes should rest on solid academic grounds and students should receive orientation in the research that underpins the theoretical and practical contents of their courses.

Over the past 20 years, there has been great interest in game research. However, very few studies address game development and even fewer have focused on development of the games most people play. The processes that game companies and their motley crews of developers use to produce successful game titles are not well understood from an academic perspective. To further complicate things, existing research is scattered across several communities that have fundamentally different academic perspectives.

Students enrolled on academic game development programmes are this book's primary target audience. Said students are often left unsupported when figuring out: how the disciplinary research presented by their professors relates to the world of work after graduation; and, equally importantly, how said research relates to the possibly completely

different academic perspectives of their future colleagues.

I argue that it is important for everyone to understand that: there are many different elements that are essential in digital game development; and, the academic homes for these elements are scattered and, as things now stand, often “incompatible”. There are many reasons behind this scattering and incompatibility. For example, the software element in digital game development involves the construction of complex systems governed by rules of logic that have great freedom. However, the resultant games are ultimately executed on hardware that is governed by physical limitations (e.g. the speed of light). The cultural element of digital game development rests on the “meaning” that emerges from the gaming experience being placed in a cultural context. Here, literature, music, movies and other human forms of expression also all have their place. The social dimension of gameplay requires developers to understand and provide mechanisms that support communication and interaction between many different players. Finally, the business element of game development introduces the demand that each game’s production, promotion and support costs are covered by revenue.

All these elements (and more) are handled by ambitious game developers. However, very few (if any) research studies address all of them. Researchers typically focus on one of the above aspects in isolation.

This book aims to present research focused on applied game development and map out the various disciplines involved. It does not seek to present a synthesis of all such (sometimes contradictory) studies. Instead, it seeks to promote understanding of the multitude of perspectives involved. Acknowledging the complexity of the map is a good starting point for anyone who wants to understand game development research. It is important to appreciate how different academic communities may be involved. One important message of this book is that there are many disparate “game studies” communities that contribute to the understanding of game development.

This book’s focus on studying “game development in the wild” (i.e. typically undertaken by game companies) rather than “game

development in the lab” is deliberate. In the wild, interesting gameplay is necessary for survival; development costs have to be covered one way or another. Development in the lab, on the other hand, may be allowed to disregard some relevant aspects so that something else can be studied. This has development implications and it may be misleading to transfer conclusions from lab to wild and vice versa.

The boundaries between disciplines have given rise to something that can be characterised as a *nationalism* that restricts research spanning many disciplines or lying outside the scope of traditional areas. This has caused some researchers to object to the concept of disciplines. One such approach is the antidisciplinary movement at the MIT media lab (Oxman, 2016; Ito, 2017). They argue that disciplinary thinking belongs to the *age of enlightenment* and that the challenges we face today, in the *age of entanglement*, require us to leave disciplinary structures behind:

The world, certainly the academic world, can be seen as a bunch of circles, which are the disciplines, and there’s a lot of white space between those circles. You can argue about how big the white space is, but there definitely is white space. If you work in the white space, you often can’t get federal funding, which, in turn, makes it difficult to generate the body of work necessary for tenure in traditional academic departments. (Ito, 2017, p. 23)

The Krebs Cycle of Creativity (KCC) shown in Figure 1.1 is a model proposed by Oxman (2016) that shows the four modalities of human creativity and how they relate to each other. Oxman uses the Krebs Cycle¹ as a metaphor for how science, engineering, design, and art energise each other:

The role of Science is to explain and predict the world around us; it ‘converts’ information into knowledge. The role of Engineering is to apply scientific knowledge to the development of solutions for empirical problems; it ‘converts’ knowledge into utility. The role

¹ A series of biochemical reactions in a cell and far beyond the scope of this book.

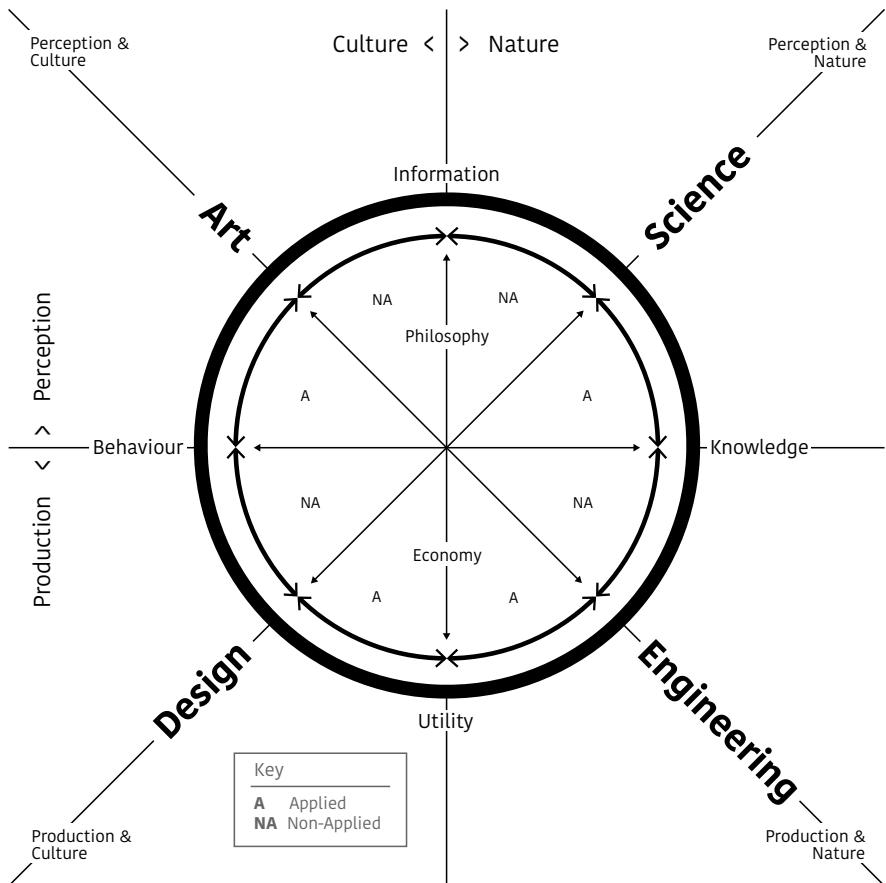


Figure 1.1: The Krebs Cycle of Creativity (Oxman, 2016) – slightly modified. Reproduced in accordance with the CC-BY 4.0 licence.

of Design is to produce embodiments of solutions that maximize function and augment human experience; it ‘converts’ utility into behavior. The role of Art is to question human behavior and create awareness of the world around us; it ‘converts’ behavior into new perceptions of information. (Oxman, 2016)

Game study and development involves all parts of the KCC. Consequently, KCC offers a good map for discussing game research and the breadth of perspectives that need to be considered. However, the antidisciplinary approach is not widely accepted in academic institutions. This makes it hard for many individuals and groups to espouse it wholeheartedly.

Students aiming for a career in games can use the KCC map to navigate the academic landscape. While profession-related tasks may require a deep dive into discipline-specific studies, the other parts of the KCC will always be relevant when returning to a focus where game development is seen as a compound activity. A professor teaching on a game programme can have a single perspective. A game producer in the wild has to care about many perspectives.

1.1 Structure and aim of this book

This book focuses on research that specifically targets the development of (regular) games. Chapters are structured to reflect the main disciplines in which said research was conducted. The main goals of this book are to: characterise game development research in each discipline; and, provide pointers to articles that report results from studies of game development.

The majority of the articles cited in this book were collected via a major literature review led by myself and conducted with the much valued assistance of colleagues. Said collection was detailed in two journal articles (Engström et al., 2018; Berg Marklund et al., 2019). Additionally, I also conducted a review of academic game development research from the perspective of the *Game Developers Conference* (Engström, 2019b). This list of studies was extended with game development focused articles published in the past four years. The presented material is by no means exhaustive and it is very likely that some important texts have not been included. The appendix gives some further details on the reviews.

Previous reviews have identified a number of areas where game development research has been conducted. Figure 1.2 shows a visualisation of these areas and how they are covered in this book's chapters. The map seeks to illustrate how different areas relate to each other and where there are overlaps. This is by no means a perfect representation. Some strongly linked areas (e.g. computer graphics and art) are shown as distant from each other in figure 1.2. Many alternative mappings are possible.

The research community has manifested disproportionate interest in games that have purposes over and above providing an interesting experience for the player. Given this overwhelming attention to “utilitarian” development (serious games, gamification, etc.), combining the results of research therein with those from research into regular game development would risk giving an entirely imbalanced picture.

I argue that it would be more than unfortunate if results from the development of games that have utilitarian goals were allowed to

1.1 Structure and aim of this book

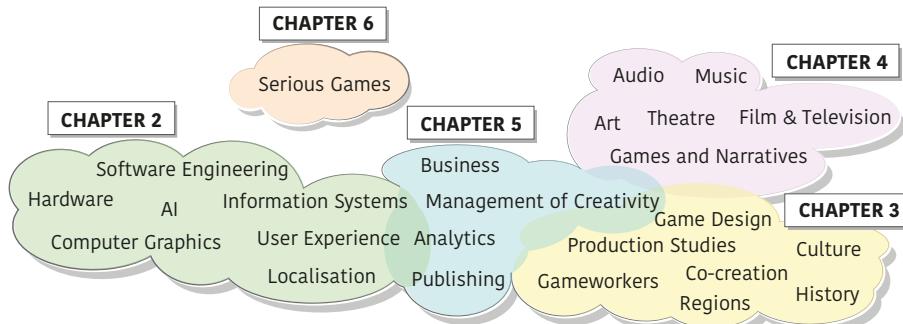


Figure 1.2: A map of the game development research areas covered in this book.

dominate. Thus, as illustrated in figure 1.2, this book addresses these studies separately.

For each area highlighted in the following chapters, I present some reading suggestions. One article is designated “must read”. In total, there are thirteen such articles. Together, they give a good overview of the breadth of perspectives represented in studies of game development in the wild.

At the end of each chapter, main forums for publishing research in the corresponding discipline are highlighted. These are good starting points for students who would like to go deeper into any specific field. This book focuses primarily on highlighting research published as journal articles, conference papers or book chapters. Access to and reading of the highlighted material is facilitated by the adopted approach. Books are largely excluded from the analysis and presentation in the present text. Going deeper into specific fields would require whole books to be added to the types of source information.

The remaining sections of this chapter minutely set out the scope of this book and provide a brief introduction to, and remarks on, the history of game research and the role of technology and tools.

1.2 The gap

In understanding research into games and game development, the differences between game development and academic research provide an important backdrop. There are fundamentally different forces acting in these latter two areas. In academia, there are “repelling” forces that make it hard to bridge disciplines and address problems that span the whole KCC. In game development, the common goal of creating a game constitutes an “attracting” force that leads to collaborations between people representing different parts of the KCC.

Ironically, the world of research can be said to share many characteristics with the world of religion. The different *faiths* have some similarities (e.g. believing in a higher power) and some fundamental differences that make it hard for them to unify (e.g. monotheistic versus polytheistic and different paths to salvation). Some *followers* are orthodox and seek to follow a *chosen* path. Others adopt and adjust more pragmatically to the surrounding society. Some followers are open to converting to other faiths, but most follow the traditions with which they have been brought up. Game development research can be seen as a gathering in a multifaith space (Crompton, 2013) at an airport. All religions are welcome, but the walls are white and empty.

Academic education and research are organised on the basis of disciplines. In turn, universities are divided into faculties, schools or departments that typically focus on specific disciplines (e.g. Faculty of Arts, Engineering Department, School of Business, etc.). Researchers from disparate fields (e.g. software engineering and communication studies) might not even accept each other’s research methods. There is a huge difference between defining formal complexity measures (e.g. Weyuker, 1988) and conducting autoethnographic studies (e.g. Blinne, 2012). As many students (and even professors) are never exposed to research outside their own disciplines, they may assume some type of conformity amongst researchers. Said conformity simply does not exist.

The criteria measuring the success of an academic career are relatively clear, namely, scholarly articles (or books) and citations. These should preferably have the cachet of emerging from or featuring in established

1.2 The gap

academic conferences and/or journals. Journals usually accept an article if two or three reviewing peers consider it to be of interest. The peers and the journal are typically part of the same community as the article's author. Consequently, most academic communication is cabalistic and does not primarily seek to bridge different perspectives. This is despite recent decades' increased interest in multidisciplinary, interdisciplinary and transdisciplinary research and education. Presumably, the prevailing system is not well prepared for these new approaches and interdisciplinary articles may be harder to publish than those that stick to a single tradition. An editorial in *Nature* summarises it as follows:

If governments, funders and universities want to encourage more basic researchers to leave their trenches, then they need to make the no-man's-land of interdisciplinarity a more welcoming place to build a career. (*Nature*, 2015, p. 290.)

Thus, the academic system still seems to steer researchers away from interdisciplinary collaborations. Conversely, game development more or less forces people together. Moreover, as regards research, collaborations do not have to be very tight – meetings, discussions and written documents are often enough. These activities do not necessarily *need* a specific combination of competencies. Even with a wide mix of disciplines, pulling off a meeting should not be impossible. All researchers can discuss and write.

Creating a digital game is a far more regimented and unforgiving task. It involves a mix of quite specific competencies. Furthermore, assembling a game is a challenge in itself and very few people master all the necessary skills. If a game were to be created solely by ten 3D modellers in a meeting, there would be a major risk that the product would lack interactivity, AI, gameplay, music and maybe even a storyline. The result would most likely have beautiful, detailed images and animations, but it might not have any interesting *gameplay*. Similarly, ten programmers would probably create a solid interactive experience, but the visual and auditory presentation might be primitive and the theme of the game stereotypical and shallow.

When an academic environment gives few opportunities for interdisciplinary collaboration, researchers may gain the necessary experience in other ways (e.g. participation in applied game development). However, this is not always possible. Many researchers are not focused on applied work and others have only experienced production in their own discipline. For example, a computer science researcher may have done some individual coding and a media scholar may have produced a film. Game jams and small individual game projects are common in the game studies community, but it is rare with participation in large interdisciplinary projects where the goal is to produce a game that attracts the interest of players. Not many scholars have participated in, or observed, applied game development themselves and they may not have been exposed to the large variety of perspectives involved. The economic dimension of development (i.e. that production costs need to be covered in some way) is addressed almost exclusively in business communities.

Many scholars are not even aware of the gap between academia and applied game development. This is apparent in a recent study presented by Passarelli et al. (2020). They present a project aimed to explore the relationship between social science research and game development, and the result reveals a big gap between the two sectors. This is presented as something surprising:

The considerable gap between these two sectors became apparent, the extent of which we did not anticipate before project investigations got underway. (Passarelli et al., 2020, p. 2.)

The main messages of this book are that: good game development requires more than one disciplinary perspective; and, all existing research approaches that do not acknowledge this are likely to suffer from shortcomings. Sadly, failure to *combine perspectives* is more common than not in academic studies of games. The computer science/software engineering community addresses games from its perspective and the humanities/social science community from its own. Their contributions are targeted at their own academic communities and

1.2 The gap

only rarely at game developers. This was also the conclusion in Passarelli et al. (2020, p.7):

... our researcher interviewees, when talking about non-academic dissemination, mostly focused on reaching teachers and educators rather than developers, confirming that developers are often not considered the main targets of research results.

Passarelli et al. appear surprised by the gap between developers and research. Unfortunately, the existence of this gap was no surprise to me after my almost 20 years of game research. Yet, it is very encouraging that there are studies explicitly highlighting the problem. Change may be on its way.

1.3 Definitions and scope

To frame the scope of this book, a definition of *game development research* is required. In turn, this necessitates a closer look at the individual concepts, i.e. *game*, *development* and *research*. This examination is followed by a discussion in which the compound term and the scope of this book are presented.

1.3.1 Game

What does the term game cover? Presenting over 60 definitions of *game* found in the literature, Stenros (2017) discusses their various perspectives and components. Some definitions see elements such as rules, challenges, clear goals and winning conditions as necessary components of a game. This means that *Sims* or creative mode *Minecraft* may not qualify as games. For the purposes of this book, it is important to have a definition which includes *artefacts* that the general public perceives as games. This is achieved by the definition used by Elias, Garfield and Gutschera (2012, p. 6) who state: “A ‘game’ is whatever is labeled a game in common parlance”².

Another popular definition that is worth mentioning is one accredited to Sid Meier: “A game is a series of interesting choices”. This definition emphasises the need for a game to present players with choices (interactivity) that, in some way or other, are meaningful. Many research projects result in interactive artefacts that appear to overlook the importance of providing interesting choices. For example, White, Tian and Smith (2016) reported that 75% of their participants found the studied game to be “not at all entertaining” and none found it to be “very entertaining”.

² They also define a subset that they refer to as *orthogames*. For them, an *orthogame* is: “A game for two or more players, with rules that result in a ranking or weighting of the players, and done for entertainment.” (Elias, Garfield and Gutschera, 2012, p. 8.) This is a useful term. It refines the very broad concept of games by defining a subset based on particular characteristics.

1.3 Definitions and scope

It is not easy to evaluate whether a game provides interesting choices. Players provide the most reliable evaluations of games³. If a game receives a lot of player attention, it is most likely providing interesting choices. Given the above, the Elias, Garfield and Gutschera (2012) definition of game is sufficient for this book.

Even focusing on game development in the wild, this book still acknowledges there are huge variations between produced artefacts. There are examples of highly successful games developed by very few developers, e.g. *Undertale*, two developers. Other games credit several thousand developers, e.g. *Assassin's Creed: Odyssey*, 3,355 developers. (Toftedahl and Engström, 2019). It is only natural that there are huge differences between the development processes in small indie projects and those in full scale AAA projects.

As regards attracting players, another important aspect is whether the game is externally funded (e.g. as a hobby project), or if the developer needs to survive in a commercial market. Conditions are much tougher in commercial game development. Here, games must attract not only player interest, but also player payments that will cover development costs. Thus, the business model has a major impact on game design and development (Davidovici-Nora, 2014). A game development project conducted with research funding, or as a hobby project, does not have to worry about return on investment.

As regards development and research, games have some additional, important characteristics that need to be considered. First of all, there are some fundamental differences between digital and non-digital games. Most of the studies cited in this book have a digital game focus. However, it should be noted that many game characteristics are independent of the digital/analogue aspect. From a development perspective, digital games introduce a substantial number of additional

³ Players includes game journalists, *YouTubers* and others influential in the gaming world.

challenges. They also offer many additional possibilities. Consequently, the games can be far bigger than their analogue counterparts. From a *game development perspective*, there is thus a big difference between analogue and digital. From a *game design perspective*, the difference may not be as large.

The genre of a game and whether it is single or multiplayer also affect the development process to some degree. Some sports games (e.g. Electronic Arts' *FIFA* and *NHL*) have massive audiences that expect to pay for yearly updates. The developer can thus plan and manage development in a controlled way. One developer referred to this as "printing money" (Murphy-Hill, Zimmermann and Nagappan, 2014, p. 6). In other genres, expectations are very different (e.g. new gameplay and content). A genre may also have certain characteristics common to all its games. This encourages the study and sharing of experience and knowledge of said characteristics. Some skills in game development are not applicable to all genres. Gaming hardware and the development skills associated therewith are extremely important factors in digital games. Hardware can empower, constrain or limit developers. In the past, new hardware has given rise to new gameplay (Lê, Massé and Paris, 2013). An obvious example is the impact the internet has had on digital games.

Finally, it should be noted that there is a big difference between *regular games* and *serious games*. The element of seriousness imposes a requirement over and above the need to attract player interest. Said imposition introduces development (and playing) constraints that have huge consequences.

1.3.2 Development

In the present context, development is the *creation process* behind a game. The use of the term is most likely attributable to the software development tradition that is present in digital game creation. When games are approached from other fields, terms such as *design*, *creation*, *authoring* or *production* may be used instead.

For many people, development is not strongly associated with

1.3 Definitions and scope

creativity⁴. A little like *assembling*, it is a process that is subservient to creation. However, in this book, development is used to cover all the elements involved in the birth of a game. It includes not only highly unstructured and spontaneous processes that give rise to new ideas, but also tedious and systematic processes used to avoid, find and eliminate software bugs.

It should be noted that interest in development processes and methods varies significantly between fields. In software engineering, there is a very strong tradition of proposing and using systematic, well-described methods. These often include standards for documenting the developed artefact. In art, design and other creative fields, there is less focus on following predefined steps. Instead, there is a much stronger emphasis on creative individuals, it being believed that any project has greater chances of success if the right screenwriter, director, composer, conductor and architect are contacted. Games differ slightly here. In general, the creativity in games is a collective process. There are some examples of game designers acquiring star status (e.g. Hideo Kojima, Sid Meier and Shigeru Miyamoto), but these are exceptions.

Game development can be seen as part of a broad and established design tradition that has been the object of theorising since long before the advent of digital games. In this context, design can include anything from the creation of visual communication, material objects or organised services to the creation of complex systems for environments and daily life (Buchanan, 1992). This field has identified and addressed many of the challenges that are also present in game development. For example, Buchanan (1992) highlights the fact that problems addressed by designers rarely fall within the boundaries of a single discipline:

Thus, we have the odd, recurring situation in which design is alternately regarded as ‘applied’ natural science, ‘applied’ social science, or ‘applied’ fine art. No wonder designers and members

⁴ In some articles, the term developer is used as a synonym for programmer. This book does not follow said usage.

of the scientific community often have difficulty communicating.
(Buchanan, 1992, p. 19.)

In the same article, Buchanan stresses the implications of design typically addressing “wicked problems”. Wicked problems have certain characteristics that make them hard to handle. For example, they cannot be definitively formulated, there are no “stopping rules” and no definitive solutions. Hence, wicked problems cannot be solved. Nonetheless, designers have to handle this “indeterminacy” as well as they can. Traditional, rational approaches to problem solving cannot be applied.

Since its start, the software industry has attracted the interest of academic research in areas related to information technology. Academia has been interested not only in studying the industry’s development processes and methods, but also in proposing new, and assumedly superior, methods. One possible reason for this is the fundamental challenges developers experienced when early IT systems were deployed. The mix of complex technology and user interaction made developers realise that engineering processes were not applicable. This challenge has been inherited by digital games and partnered with requirements related to non-utilitarian usage and art. Other parts of the entertainment industry (e.g. movies and music) do not have to handle the same type of formally modelled interactivity. A movie director always knows that audiences will see scenes in the prescribed order. Research communities focused on movies, literature and music do not seem to be strongly interested in the production processes behind the artefacts. Instead, the majority concentrate on analysing the resulting artwork.

The overarching risk that the work will result in nothing at all is a fundamental characteristic of software development. I feel this is often overlooked by people who have limited programming experience. Software bugs can appear at any stage of development. They can be game-breaking (the program may not even launch) and it may be impossible to determine how much time is needed to correct them. Of course, art, music or narrative creation can also suffer from software

1.3 Definitions and scope

failures or mistakes that necessitate additional work (see e.g. Whitson, 2018). However, the creator rarely has to worry about not producing anything at all. Here, it is the quality of what is produced that is at stake. If a movie's special effects have glitches, the movie can still be watched. This paves the way for less structured working processes and more relaxed attitudes to the produced artefact. The advanced tools, debuggers and testing techniques used by programmers are a consequence of the high stake risks they constantly live with. Even the smallest patch can make a whole game crash. Isolating the underlying reasons for the crash can be immensely difficult.

Within academia, the management research community does focus on production processes in the creative industries. As product sales become increasingly driven by non-functional properties (e.g. design and lifestyle values), companies want to control how these values are created. Along with other parts of the IT sector (e.g. social media, music and movie streaming, etc.), games are commonly mentioned in creativity management studies. Some of the most insightful characterisations of game development have been presented in this field.

To conclude, studies of collaborative development have primarily been the focus of management and IT research. When applying results from traditional industrial contexts, the cultural, creative and non-utilitarian elements that are central to games call for caution. The qualities that are most important for games are similar to those that are used to evaluate movies and music. However, the interactivity and technological elements of games mean that they have inherited the challenges of IT development. The situation is summarised well by Tschang (2007, p. 990):

Game development differs from the development process of other creative industries in that it needs computer programming, design, project management, and substantial amounts of testing.

Since this article was published in 2007, new application areas have arisen (e.g. social media and lifestyle apps) that have characteristics

similar to those of games. Developing such applications will require the partnering of IT development and the “production of culture”. Creativity is important not only in game development.

1.3.3 Research

The Oxford Learner’s Dictionary defines *research* as: “A careful study of a subject, especially in order to discover new facts or information about it”. Such research is conducted in many different contexts, not least in companies seeking to solve problems and develop new products. This book focuses on *academic research*. The additional characteristics of this latter differentiate it from most research conducted by companies.

Important characteristics of academic research

There are some pragmatic aspects of academic research that must be highlighted and which *justify* it vis-à-vis corporate development. First of all, academic research should be *available*. Traditionally, since the days of the ancient Greeks, research has had to be *published* so that its claims can be scrutinised and discussed by peers. It is no coincidence that the Greeks invented both democracy and science. Research conducted in non-democratic contexts may have to be *adjusted* so as not to fall foul of the ruling powers. Such adjustment can jeopardise quality. One of the best-known examples of this is Galileo Galilei’s trial for promoting heliocentricity. The Roman Catholic Inquisition could not accept a model in which the planets revolved around the sun.

As intimated above, peer review is another important characteristic of research. Most results published in academic contexts have been reviewed and studied by other academics in the same field. Results are not made available unless approved, in some way, by worthy reviewers. The peer review system does not entail all researchers agreeing on everything. Quite the opposite. Different academic fields have developed very different traditions and very different theories on how knowledge is created. Something that is considered solid research in one field can be completely rejected in another. To the point of polemic, some researchers contest any explanations that challenge their own. The

1.3 Definitions and scope

prestige of being the person behind a promoted perspective should not be underestimated⁵.

A third characteristic is that research should be independent or at least have any conflicting interests clearly presented. For example, to establish its credibility, cancer research funded by a tobacco company has to overcome the real or apparent risk of a conflict of interest.

Finally, there are ethical guidelines that researchers need to follow. This is something that has not always been emphasised. History has terrible examples of humans being exposed to cruel treatment in the name of scientific research. There are no clear boundaries between what is and what is not ethical research. For example, animal testing is a controversial topic. When does it become unethical? However, the important point here is that there are ethical rules, regulations and principles for academic research. In some cases, these go beyond the requirements of civil/common law.

Research philosophy

The above-identified characteristics embody a quite pragmatic view of research. A more formal characterisation might require a review of research philosophy. This is not the place for such an examination. However, there are some fundamental tenets of research philosophy that are worthy of attention.

Game development research covers a very wide range of disciplines and traditions. Many readers of this book may have been exposed to only one or a few different traditions. The most fundamental differences relate to *research paradigms* (Guba and Lincoln, 1994) and how reality and knowledge are perceived. A research paradigm is a fundamental pillar on which research rests. It transcends the issue of whether a qualitative or quantitative method is to be used. Guba and Lincoln (1994) describe a paradigm as a set of basic beliefs, or worldviews:

The beliefs are basic in the sense that they must be accepted simply

⁵ Interestingly, this can be seen in the struggle between the church and Galilei. A geocentric view is not inherently wrong. However, it makes modelling planetary motions far harder.

on faith (however well argued); there is no way to establish their ultimate truthfulness. (Guba and Lincoln, 1994, p. 107.)

Commonly mentioned paradigms are positivism (and *post-positivism*), *critical theory*, *constructivism* and *pragmatism*. In their ontological⁶ assumptions, there is a fundamental difference between the positivist and the other paradigms. In positivism, reality is assumed to exist irrespective of humans. The other paradigms do not rely on this assumption, but emphasise the roles human culture, social systems, context, etc. play in shaping reality. This fundamental difference in the perception of reality has implications as regards how knowledge is believed to be created (epistemology) and how a researcher can generate knowledge (methodology).

The positivism paradigm has long dominated traditional science. Studies in physics, medicine, etc. often focus on concrete phenomena whose existence most people would not doubt and where the scientific results have led to tangible results (e.g. laser cutters and antibiotics). Such research seeks to explain the studied phenomena and to generate results that can be used to look into the future. The success of the paradigm in science led to a movement for applying it in other fields as well. It was often less successful here. In areas where human behaviour and social interaction play a central role, it is harder to see absolute realities. Our language, culture, personalities and group interactions influence both the researcher's understanding and the characteristics of the studied phenomena.

Another problem with positivism is that it excludes the discovery steps in research and focuses on testing existing observations. Conversely, in the constructivism paradigm, the focus is on understanding a specific reality (acknowledging that it is socially constructed). Here, there is less focus on looking into the future. The aim is to understand and present a perspective in an informed and rich way.

Critical theory is similar to constructivism, but focuses more on social transformation rather than on simply explaining and understanding.

⁶ Ontology is the philosophical study of being.

1.3 Definitions and scope

Finally, pragmatism focuses on using the components that work for each specific problem. It is not primarily concerned with the ontological perspective discussed above. In the pragmatist paradigm, rather than deep discussions about truth and reality, the major concern is the solving of real problems.

Much more can be said about research philosophy and research paradigms but, for the purposes of this book, there is no need to go into greater detail. The important thing to note is that game research features all the above-discussed paradigms. There is no consensus on any of these aspects. Thus, it is misleading to talk about *a* game research community. The democratic principles discussed above apply to individual communities just as if they were countries. Although there are many countries in the academic game world, there is no United Nations.

Art research

Art research is not addressed above. Mainly due to my very limited experience of such research, this section will not be very long. Nonetheless, because some games can be seen as art (Rough, 2016), art is relevant in game development. There are several academic art institutions that study games. Art research has echoes of constructivism, but is different in that it is concerned with the “artist process” itself. The experiences in this process can be documented, shared and used to inform other researchers/artists. Lilja (2015, p. 14) proposed the following definition: “Artistic research is research conducted with artistic practice as its base and artistic practice as its object”. Art research can thus be seen as having both the means and the goal in the same activity. This makes it different to other types of research.

Multidisciplinary, transdisciplinary and interdisciplinary research

There are many different terms used to characterise collaborations between disciplines. To complicate things further, there is no unified definition of these terms. In some contexts, interdisciplinary work is defined as the transfer of methods from one discipline to solve a problem in a different discipline. Multidisciplinary research is different in that

several disciplines address the same problem, but unified results are not the aim. However, this is the focus of *transdisciplinary* research. Here, disciplines collaborate to address a shared problem and to create a shared, unified, new understanding, theory, etc. Common to all these approaches is that they are defined and based in the concept of disciplines. How far researchers drift from their disciplinary structures varies, but it is always assumed that they have a base in a single discipline.

In this book, *interdisciplinary* is used as an umbrella term for approaches that involve some kind of collaboration over disciplinary boundaries.

1.3.4 Game development research

After this quite extensive presentation of the individual terms, it is time to focus on the compound term *game development research*. This book focuses on presenting *research results from studies of game development in the wild*. In other words, empirical data used and presented as part of a research project and originating from game development as (typically) conducted in a game company.

I exclude studies of games developed in a purely academic context. Hence, a large percentage of game-development focused publication is excluded because it has numerous studies based on student projects or in-house development at universities. Although many such studies contain high quality research that may be useful in game development, it is often apparent that the development is not representative. For example, the team may have been comprised entirely of programmers or the game may never have been completed.

The game industry involves a lot of support activities (community management, business development, etc.). While these activities may be central to the business aspects of these companies, they are only included in this book if they have a clear link to core development activities. Thus, studies that address companies' social media strategies are excluded unless they relate to how game development is affected by, for example, social media integration.

1.3 Definitions and scope

This book includes research from many different communities and traditions. The criteria for source inclusion are based on the principles applied in the search databases that were used. Primarily, these were Scopus and Google Scholar. The latter indexes student dissertations. Such dissertations were excluded as, in general, their quality is lower than that in work conducted by senior researchers. The types of publication cited in this book are: journal articles; conference papers of at least 4 pages⁷; and, book chapters (e.g. from an edited collection) indexed in research databases. As mentioned above, books are largely excluded from the analysis and presentation.

⁷ Some conferences publish abstracts that can be one or two pages long. This is mostly too short to convey results clearly.

1.4 A brief history of games and research into these

Spending some time on reviewing history is a very good way of gaining greater insight into why things are the way they are. This is true for most subjects. When teaching technology, it can be hard to get students to look at the old dusty stuff. They tend to focus on the new shiny things. Nonetheless, the dust may hide many interesting ideas and experiences that can illuminate our understanding of shiny things. Thanks to the strength and longevity of a retrogaming trend, it is somewhat easier to promote the value of history in a game context. The joy these old games give is a good starting point for studying the people, technology and contexts that gave rise to them. Aycock (2016) reports that his work on “retrogame archaeology” gave him this insight:

What I found surprising in my research was that many retrogame implementation techniques had modern applications, and not only in games. I won’t go so far as to say that retrogames were the first to use these techniques or that modern uses are directly inspired by retrogames, but I will claim that retrogames are an interesting way to learn about them. (Aycock, 2016, p. vii.)

Non-digital games have long been studied by (predominantly) historians and sociologists. At its start, the digital game revolution did not attract much attention. However, in recent years, many game researchers have begun to focus on the history of digital games (e.g. Swalwell, Ndalianis and Stuckey, 2017; Jørgensen, Sandqvist and Sotamaa, 2017; Eyles, 2016; Montfort and Bogost, 2009). This includes documenting and analysing the important discoveries, inventions and productions of mostly small studios in various places in the 20th century. The *history of games* academic conference series (History of games, 2020) is organised and run by researchers from all over the world.

In recent years, museums and archives have also put increased effort into preserving and presenting the history of games⁸.

⁸ I can strongly recommend the *Computerspielmuseum* in Berlin.

1.4 A brief history of games and research into these

This section gives a brief introduction to the history of (mainly) digital games. It also presents the history of game research and the history of serious games. The final subsection contains reflections on the history of video games in relation to the KCC.

1.4.1 Analogue games

This book focuses on studies of digital game development. Thus, it does not go into detail about studies of games or gameplay (analogue games are particularly glossed over). I make an exception for three scholars, namely, Huizinga, Caillois and Csíkszentmihályi. They have had a major influence on digital game research and game design.

In 1938, Johan Huizinga presented a seminal work, *Homo Ludens* (the playing man), in which he suggests that play is central in the development of culture (Huizinga, 1955). He further characterises play as an activity and introduces the concept of *the magic circle*. This has frequently been used in later studies of games.

In the early '60s, Huizinga's ideas were developed by the French sociologist Roger Caillois in his book *Man, Play and Games* (Caillois, 2001). Besides core characteristics of play, Caillois proposes categories for different forms of play. The results are principles that can be used to characterise play in a wide sense (sport, amusement parks and "free play" included therein).

Mihály Csíkszentmihályi, a psychologist, identified and defined the concept of *flow*. Flow is a state of mind that people can enter when they perform various activities. It is characterised as an "optimal experience" (Csíkszentmihályi, 1990). Playing games is one activity that can lead people to enter a flow state. Csíkszentmihályi highlights the importance of having a balance between challenges and skills. This is essential for flow and has been applied in game design (e.g. see Schell, 2008).

Huizinga and Caillois were mainly concerned with play as an activity. Csíkszentmihályi focused more specifically on the state of mind that players may enter. Although none of them studied game development, their theories have had repercussions for game design studies. Consequently, it is relevant to mention them in this context.

1.4.2 Digital games

Alan Turing was one of the first scholars to address digital games. In 1937, he presented *On computable numbers* (Turing, 1937), an article that targeted a mathematical problem, but which proposed a computer and computation model that is still used today in computer reasoning. During the Second World War, Turing was one of the key people behind the creation of one of the first programmable digital computers. He was also one of the first to see the potential of computers for playing games (Turing, 1953).

After the war, Turing was involved in the development of the Manchester computer. His contribution to the hardware was a random number generator. He needed this to create a random love poem generator (at a time when computers were mainly used for military purposes). Turing also started to study how to create a computer chess program. His reasoning on machines and intelligence initiated the field of artificial intelligence (AI). Since then, AI research has been an important part of game research. Interest has largely focused on orthogames but, in recent years, increased attention has been paid to human-like AI. Here Turing's proposed "imitation game" is still highly relevant to attempts to create believable AI in games (Livingstone, 2006). Turing is clearly a central figure in the history of computing and games (Björk, 2013).

In Scandinavia, Piet Hein was an early game scholar. Surprisingly, the game community has paid him little attention. A polymath, he was mainly known for his poems⁹ and his use of the superellipse in the design of furniture and roundabouts¹⁰. He was also a mathematician and game designer. His best-known game is *Hex*, which he presented as *Polygon* in 1942. The same game was later re-invented by the American

⁹ One of his best-known poems was published during the Nazi occupation of Denmark. The Danes realised it was an allegorical call to maintain resistance: "Losing one glove is certainly painful, but nothing compared to the pain, of losing one, throwing away the other, and finding the first one again". Nazi censors entirely missed the allegorical meaning.

¹⁰ His work on Sergels Torg in Stockholm received a lot of attention in the '60s.

1.4 A brief history of games and research into these

mathematician John Nash. They appear to have “discovered” the game independently (Maarup, 2005). Another of Hein’s games was *Nimbi*. This simple board game was designed as an extension of the ancient *Nim*. In 1901, French mathematician Charles L. Bouton had published an article (Bouton, 1901) revealing the optimal strategy for winning *Nim* games. Hein thought that Bouton had killed the game and wanted to resurrect it with *Nimbi*. His game did not have any obvious winning strategies and Hein became interested in exploring how a computerised *Nimbi* player could be created. Through a collaboration with the Danish *Regnecentralen*, a digital version was presented in 1963 (Jørgensen, 2009). Besides being one of the first digital games in Scandinavia, it was also one of the first digital games to have an interesting game design. The majority of earlier projects had been implementations of noughts-and-crosses and *Nim*, both of which have clear winning strategies.

In the ’50s and ’60s, digital computers were little known outside scientific communities; digital games even less so. As computers were extremely rare and expensive, digital game research was very much the preserve of engineers and scientists. Early research projects in digital games were mainly conducted on a proof-of-concept basis or to get the general public interested in computers. Some researchers saw the projects as steps towards the goal of using the technology to address other problems:

It seems reasonable to assume that these newer techniques will be applied to real-life situations with increasing frequency, and that the effort devoted to games or other toy problems will decrease.
(Samuel, 1960, p. 192.)

This attitude persisted for a very long time. For example, most research funding was (and still is) aimed at applying results from game development to “real-life situations”.

SpaceWar! (figure 1.3) is one of the early games that had immense impact on the digital game revolution. It was created in 1962 by a group of programmers at MIT (Monnens and Goldberg, 2015). The creation



Figure 1.3: Screenshot of a PDP-1 computer running SpaceWar! Image by Kenneth Lu, reproduced in accordance with the CC-BY 2.0 license.

of *SpaceWar!* was not initiated by research questions or business plans, but by curiosity and a desire to create something that could provide amusement. The game was a success¹¹ and started to be copied and replicated at other computer centres across the USA:

Programmers who encountered the game became addicted and eventually brought a copy to their own labs or programmed new versions based on what they remembered. (Monnens and Goldberg, 2015, p. 126.)

Eventually the game reached entrepreneurs who developed it into arcade machines. *Computer Space*, considered to be the first commercial digital game (1971), was produced by Nolan Bushnell who later started the Atari game company. Soon after, Atari released *Pong*, the first major digital game success. The success of *Pong* led to strong growth in the game industry in the '70s.

Interest in games saw a dip in the '80s when the market suffered a severe recession. Even major stakeholders such as Atari had to close down. This video-game crash mainly affected western companies. In the same period, the Japanese game industry grew strongly and started to expand westwards (Izushi and Aoyama, 2006). Simultaneously, various

¹¹ Interestingly, the game was used in the very first e-sport event; the 1972 *SpaceWar! Olympics* at Stanford University.

1.4 A brief history of games and research into these

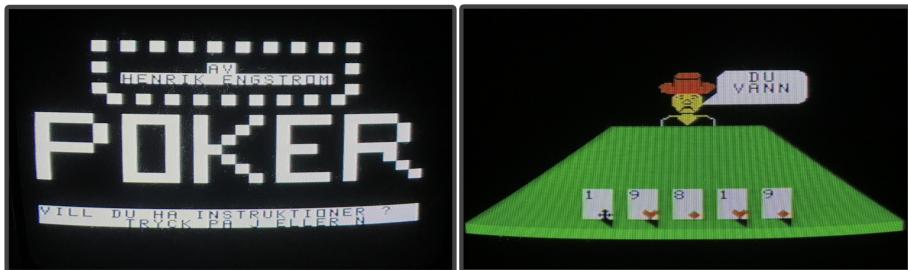


Figure 1.4: A poker game I developed in 1983 for the TI-99/4A home computer.

types of home computers (microcomputers) started to be released, attracting, in particular, the interest of teenagers who wanted to play digital games. Some users, myself included therein, also developed an interest in developing their own games (see figure 1.4). This led to a real boom in game releases. It was followed by strong expansion in ownership of home PCs and improved hardware such as 3D graphic accelerators (graphics cards). All elements of the gaming experience developed rapidly in the '80s and '90s. The social dimension of playing was added when the internet reached most (western) households in the '00s.

The most recent big shift for digital games began with Apple's introduction of the iPhone in 2007. Hand-held gaming had been introduced very early, but the smartphone enabled gaming for the masses. Today, mobile games dominate the market. More or less everyone plays digital games. This revolution has taken place in just 70 years. My mother was born four years before Alan Turing published "On Computable Numbers..." She now plays games on her iPad.

1.4.3 Digital game research

It took a long time for the research community to show serious interest in the remarkable digital game revolution. Although the first games were conceived in research labs, digital game development was mainly driven by commercial interests and personally motivated individuals (e.g. who

wanted to express themselves or to amuse themselves and others). With little time for reflection, development methods were devised along the way:

Not only have game developers been constructing the labyrinth of game development as they go, they have been doing so in such a hurry that they have not bothered carrying any thread along.
(O'Donnell, 2009, p. 12.)

The research community's interest in games started to soar by the turn of the millennium. Figure 1.5 presents statistics from the Scopus research database when queried for articles having “video game”, “computer game” or “digital game” in their title, abstract or keywords. In parts per million (PPM), the figure shows each year's result as a fraction of the total number of articles published in that year. The reason for this metric is that the total number of research publications also increased across the same period. For example, compared to 2010, 2019 had 39% more articles. Thus, the PPM metric shows the relative interest in game research.

In total, there were more than 35,000 articles matching the search terms. Only 3% of these were published before 2000. By that time, digital games had grown to be an important force in the entertainment industry. Furthermore, a generation that had grown up with such games was then starting to get involved in research¹². The fraction of research involving games has seen an almost linear growth. Since 2015, more than 1,000 PPM (or 0.1%) of all research articles address digital games. However, of this research, only a tiny fraction addresses *game development* (see figure 1.6).

With the establishment of the *Game Studies Journal* (Aarseth, 2001), the *Digital Games Research Association* (DiGRA) and the *DiGRA conference*, the field of game studies was born in the first years of the '00s. Analogous to media studies, the main perspective of game studies has seen a focus on games and gameplay. In other words, with the

¹² Myself included therein. My first article on games was published in 2001 (Niklasson, Engström and Johansson, 2001).

1.4 A brief history of games and research into these

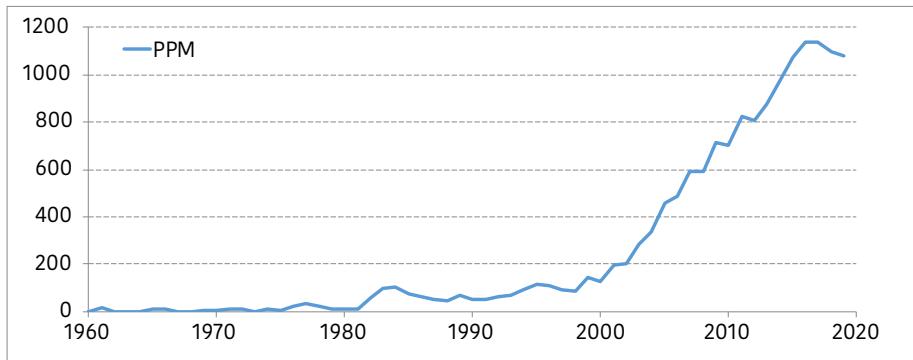


Figure 1.5: Fraction of digital game articles in relation to total number of articles in Scopus. The y-axis scale is parts per million (PPM).

spotlight on play and players, there has been very little focus on game creation. Game design has been included to some extent, but research on technical aspects of games has mainly been conducted in other communities organised by bodies such as ACM or IEEE.

Over the past ten years, the area of game user experience (or game user research) has received increased attention from both research and industry. With a tradition of experimental user studies, this is a field with roots in human-computer interaction and user experience. Game user experience has managed to establish good integration between industry and academia (Engström, 2019b). This may be because, when establishing their game user experience labs, many large game companies recruited researchers. These researchers maintained their networks in the academic community. Such connections are lacking in many other fields where staff recruitment has mainly focused on game developer skills. Many game companies do not even require recruited staff members to have a bachelor's degree.

1.4.4 Serious games, educational games and gamification

Since the very start, the academic community has had a strong interest in using games for purposes other than amusement. Analogue games such as chess and other board games have long been used as educational tools.

An interesting, early 20th century example is *The Landlord's game*. This was created by Elizabeth Magie as a way of showing the shortcomings of capitalism. The game was later “borrowed” by Charles Darrow who managed to get it patented. Since then, under the name *Monopoly*, it has been one of the most profitable board games ever. Interestingly, the original principle Magie sought to show has survived. The end of any *Monopoly* game is a really disappointing experience for everyone except the richest.

Games and simulations share many traits. Training was an early use of games and game technology. This includes different waves of virtual reality research. Dating back to 1970, *Simulation & Gaming* (Sage, 2020c) is one of the oldest journals focusing on games.

When digital games started to appear, they were soon used for educational purposes. One of the first such games was *The Oregon Trail*, first released in 1971 (Djaouti et al., 2011). In the '90s, the concepts of *edutainment*, *educational games* and *learning games* received a lot of attention. In the '00s, this was replaced by a strong focus on *serious games*. These have a wider scope. They include, for example, games designed for *advertisement* and *attitude change*. In the '10s, the focus changed once again, this time towards *gamification*, i.e.: “The use of game design elements in non-game contexts” (Deterding et al., 2011, p. 10). The differences between these concepts can be debated. For the purpose of this book, it is not important to draw a big distinction between educational games, serious games or gamification. They all share the idea that these games (or game design elements) should be used not only for amusement. The term serious games will be used as a collective term that includes all approaches that use games or game design for functional purposes¹³.

There are several reasons for not combining research results from serious games and simulations with those from regular games. Firstly, despite the huge research interest, there are very few examples of successful serious

¹³ *Functional games* is a term that is used in, for example, China.

1.4 A brief history of games and research into these

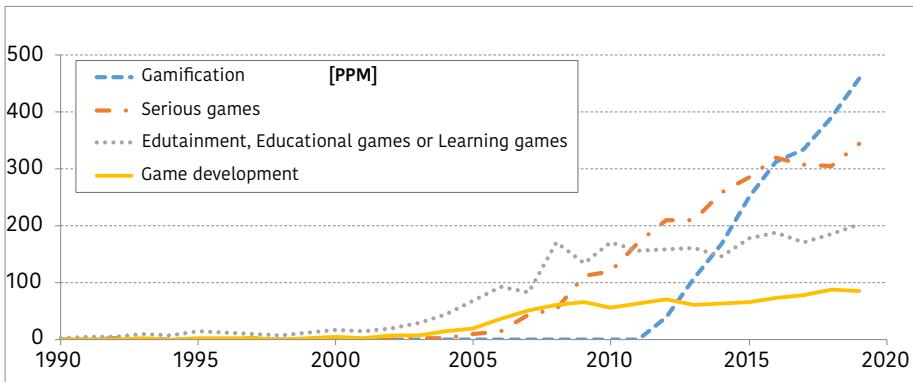


Figure 1.6: Fraction (in PPM) of articles in Scopus matching different terms related to serious games and the term “game development”.

games that have survived once research funding has ended. Secondly, the requirement that such games satisfy some goal in addition to attracting player interest makes their development very different from that of regular games. Finally, for the past 30 years, research has overwhelmingly focused on the *serious* rather than the *regular*.

Figure 1.6 shows the fraction (as PPM) of all Scopus-indexed research containing different terms related to serious games. Three title-abstract-keyword searches were made. The first was for “gamification”, the second was for “serious games” and the third was a disjunction of terms related to learning games¹⁴. As a comparison, a search was made for “game development”. Note that this last search overlaps with the other¹⁵. From the figure, it can be concluded that game development has always appeared less frequently than the other terms. In relation to all the other terms, game development occurs approximately an order of magnitude less frequently.

¹⁴ “edutainment” OR “educational game” OR “learning game”.

¹⁵ As an example, a search for “game development” AND NOT “serious games” returns 15% fewer results.

1.4.5 A note with respect to KCC

It is interesting to note that game history can be said to have evolved clockwise around the KCC (starting in the upper right corner). The first digital games were created by applied mathematicians and scientists (e.g. Alan Turing and Piet Hein¹⁶). These pioneering scientists saw the potential of a recently invented machine, but the games they created were only proof-of-principle prototypes and did not reach a large audience.

Engineers were needed to turn these early prototypes into useful solutions that could reach the mass markets. This brings us to the lower, right corner of KCC. In the early days of arcade games, development was driven by engineers. Ralph H. Baer, who created the *Magnavox Odyssey*¹⁷, was a television engineer. Nolan Bushnell, founder of Atari, is an electrical engineer. In Japan, Tomohiro Nishikado, an engineer, developed *Space Invaders* and Gunpei Yokoi, who had a degree in electronics, developed the *Game & Watch* handheld consoles. The games created by engineers were technically useful, but often lacked a cultural grounding.

While the west's game industry was deeply rooted in engineering traditions, Japan's was tightly bound to the manga and anime industry (Izushi and Aoyama, 2006). This brought in influences from a design perspective (the lower left part of KCC). Shigeru Miyamoto, who started as an apprentice to Yokoi, entered the game industry with an exam in industrial design. He also had a strong interest in manga and made use of this perspective in creating games such as *Donkey Kong* and *Super Mario Brothers*. Another well-known game developer with a mixed background is Will Wright, the (leading) creator of *Sim City* and the *Sims*. His background is architecture, mechanical engineering and robotics. Although these '80s and '90s games had a clear grounding in popular culture, they can be seen to lack deeper meaning and artistic depth.

Over the past 20 years, games that express more complex,

¹⁶Although both of them were polymaths, their main academic contributions were in scientific areas.

¹⁷This is considered to be the first home video game console.

1.5 A note on technology and tools

emotionally and artistically interesting experiences have become more common. People with artistic intentions have started to use games to express themselves (i.e. we have moved to the upper left corner of KCC). One example is Jenova Chen, a Master of Fine Arts (University of Southern California) who, for example¹⁸, created the game *Journey*, which could be regarded as a work of art (Rough, 2016). Jason Rohrer is another example of a game developer who has developed games that may qualify as art (Devine, 2017).

Oxman argues that science, engineering, design and art are the four “modalities of human creativity” (Oxman, 2016). From the examples above, it is clear that they are all present in game development. It is no longer possible to reduce games to only one of these modalities. I would argue that games have now reached a point where all four modalities are relevant and that development approaches that do not use all of them will fail to unleash any game’s full potential.

1.5 A note on technology and tools

The academic community can be said to have sat in the back seat and let others do the driving. Nonetheless, hardware-related results have been one important input from academia to the digital game revolution. Hardware innovations have been embraced and used to create new forms of gaming. The following are examples of innovations that have led to new forms of digital games¹⁹:

- 1950s – Programmable, digital computers made digital games possible.
- 1970s – Integrated circuits led to a breakthrough for home consoles.

¹⁸ He also conducted research where he addressed the concept of flow in games (e.g. Chen, 2007).

¹⁹ The years do not relate to first appearance, but to approximately when the innovations had a major impact on games.

- 1980s – Microcomputers led to a breakthrough for bedroom game development.
- 1990s – Graphics cards led to a breakthrough for 3D games.
- 2000s – The internet led to a breakthrough for massive multiplayer games.
- 2010s – The smartphone led to a breakthrough for mobile games.
- 2020s – Virtual reality (VR) devices may lead to a breakthrough for VR gaming...

It is hard to argue that these inventions did not lead to major shifts in the types of digital games people could, and wanted to, play. Academia had a central role in the invention of the majority of these technologies. Although the game industry has been good at utilising and fertilising new technologies (as well as bringing them to a mass market), the role of academia cannot be ignored here.

Technology is why digital games came into being. It has continued to play a central role in the development of the field. Early studies highlighted the choice and development of game engines as being challenging for developers. For example, Tschang (2005) examines a case involving legendary company id Software and observes:

However, while this solved the issue of building an engine from scratch, it created problems with their level design, since each time id Software modified the engine and provided a new “code build” (i.e., a version of the code incorporating the recent changes in the programming) to the developers of Elite Force, the latter’s level designers had to alter all their levels to keep up with ‘changes in the code and how it handled surfaces, lights and architecture’. (Tschang, 2005, pp. 122-123.)

Since then, powerful game engines with high-level interfaces have become available to anyone who wants to develop a game. Engines such as Unity or Unreal provide powerful capabilities at a reasonable cost. However, the general-purpose engine is not the only tool needed to develop games. To deflect focus from the game engine, a colleague and I

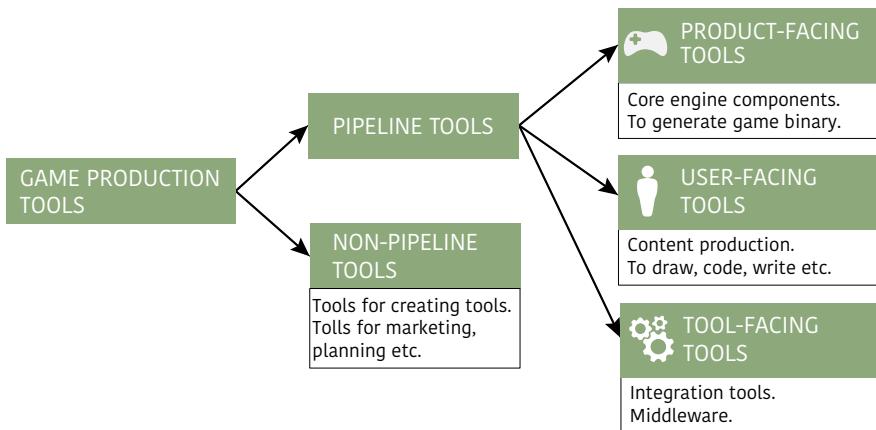


Figure 1.7: A taxonomy of game production tools (from Toftedahl and Engström, 2019).

(Toftedahl and Engström, 2019) propose a distinction between the various tools used in the game production pipeline and present a taxonomy of tools used in game production (figure 1.7). This differentiates between: product-facing tools that ultimately produce the game binaries; user-facing tools that are used by developers to produce game content; and, tool-facing tools that integrate or extend other tools. There are also tools used in game development that are not integrated in the pipeline, but are used to support other functions such as business and marketing.

The technical characteristics of the product-facing tools are still very important to game companies. The core of a game engine performs extremely advanced tasks. For example, it compiles all code and assets into a binary that can be executed efficiently on target platforms. Some game developers need to work close to this type of tool. However, the majority work with high-level, user-facing tools. Having a user-facing tool that integrates with the production pipeline and makes tasks easier is important for most game developers. Whether or not this tool is an integrated part of the game engine is less important. A too strong focus on

general-purpose game engines may result in a misleading understanding of the role of tools in game development.

1.6 Limitations

All material presented in this book has been published in English. The perspective of said material is predominantly that of western research and western game development. In a previous literature study involving myself (Engström et al., 2018), 85% of the analysed articles studied North American or European game development.

The regional dimension in game development cannot be ignored. Several studies have shown great variations between countries (Cao and Downing, 2008; Banks and Cunningham, 2016; Casper and Storz, 2017). There is a difference between North America and Europe (Izushi and Aoyama, 2006) in how games are created. The Japanese game industry's many unique characteristics (Ernkvist and Ström, 2018) strongly differentiate it from western industries. Studies from Japan published in Japanese are not easily accessible to western researchers. China has grown to be the largest game market. It is also the largest country in terms of game production. Other parts of the world such as South America and South Korea have significant game production and gaming communities. I have more than once found game development articles in Portuguese that appear to contain interesting studies, but which cannot be included owing to language barriers.

The implications of regional differences are often not highlighted in game development studies. This book does not delve into them either. Thus, it is important to remind the reader that there is a strong western perspective here.

The research that is included was identified through searches in research databases such as Scopus, SpringerLink and Google Scholar. Although these cover a broad range of disciplines, they may be biased towards certain fields. They may also contain texts that are typically not accepted as original research by the community in question. The present book includes journal articles, conference papers and book chapters. This means that complete books (monographs) have not been included in the

analysis²⁰. It also means that doctoral dissertations have not been included. Some PhD students only publish their research as monograph dissertations. However, the vast majority also publish their main results via conferences and journals. In some academic communities, monographs are used to publish original research that is not published elsewhere. Thus, the exclusion of monographs is potentially a limitation.

One objection to having a very strong focus on the existing game industry and existing games is that it risks perpetuating problematic structures. A potential example is the existing representation of people who do not identify as young, white, heterosexual males. Academia has a role to play in questioning existing norms and finding new expressions. This is an important role. However, a system has to be understood before changes can be rationally proposed. It is very hard to improve something that is not well understood. Game development is not well understood in the academic community. Thus, this book deliberately focuses on studies of development *in the wild*. Rather than questioning the norm, this often focuses on it.

Another question that is commonly raised when discussing digital games is that of gaming's potentially negative consequences. These include the: negative effects of consuming and enacting violent content; social and medical problems excessive gaming can lead to; and, connections to gambling and non-ethical business models. All these areas are well covered in academic studies and it is important to address them. Nonetheless, they are not very important given this book's aim, context, etc. For example, a text focused on creative writing would not be expected to spend a lot of time analysing the: prevalence of near-sightedness amongst librarians; working conditions in Kazakhstan's printing industry; or, copycat suicides linked to *The Sorrows of Young Werther*. Excessive gaming can have negative consequences and games can include morally questionable content. Game developers have a

²⁰The inclusion of game design books is an exception (see section 3.2.1).

1.6 Limitations

responsibility to avoid producing harmful products. This is a responsibility that the game industry shares with many other industries, not least the weapons industry.

Another limitation was my own understanding of the fields in question. It is impossible for anybody to have a detailed understanding of all aspects involved in game development. My academic background is mainly technical. My understanding of art, social science and humanities is primarily from observations and discussions with colleagues and friends as well as from books and other media consumption. In some research, I have noticed other authors' lack of understanding of technical aspects. For example, some authors treat complex technical challenges as if they were simple tasks anyone could be asked to solve. I realise that my text will contain the same sorts of weaknesses, but in relation to other areas.

This book's characterisation of disciplines is only one of many possible such characterisations. The placing of individual studies and individual researchers in specific disciplines is schematic. It is not sure that all authors highlighted in a certain area would agree that they belong to it. Thus, I preemptively apologise for any "undesired labelling".

Throughout this text, I refer to my own work and opinions using "I", "me" or "mine". The use of the first person in academic texts varies greatly between different paradigms. Adhering to a positivistic paradigm, it may make sense to remove the author from a study and "focus on the objective truth". In other paradigms, it is important to acknowledge that an author's background affects the understanding of studied phenomena. "Pretending" that an author is not part of the research would be senseless. Thus, while some readers may perceive any use of "I" as sloppy, others might object to the use of passive formulations. In themselves, such differences in writing styles illustrate the great divide between research paradigms.

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1.7 Acknowledgments

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2. Software development

Arguably, digital game development is deeply rooted in the fields of software development and computer science. As these have their origins in computer engineering institutes, digital games share their heritage with “traditional” software sciences and have followed similar development paths. Early computer science institutions had a strong emphasis on technological aspects. This was followed by a focus on organisational aspects and, eventually, on human aspects of sociotechnical systems. The latter includes a focus on man-machine interaction and user experience. In recent decades, information technology has established a presence in all facets of our society and is used by everyone – from toddlers to senior citizens. This has many repercussions for development.

As will be apparent in this and later chapters, game development has many elements that differentiate it from traditional software development. These differences are so substantial that it can even be questioned whether game development should be considered part of the software industry. O’Donnell (2012) argues that it is not and highlights important differences in, for example, the: role of the user/player; studio environment; and, production of culture. These are valid arguments and should be borne in mind when mentally approaching the studies in this chapter. However,

Chapter 2. Software development

the production challenges addressed in this chapter are present in most software and game development. So, even if the game industry is not a software industry, the former inherits many of the latter's challenges.

2.1 Software engineering

When software development evolved in the '50s and '60s, the growing complexities of new technologies and their use contexts created challenges in the planning, management and execution of software projects. To deal with this complexity, software engineering increasingly assimilated influences from methods found in applied sciences, mechanical and industrial engineering and management research (Mahoney, 2004). Although many principles from these fields were found to be highly applicable and useful in software development, there were some fundamental mismatches between the theoretically correct way of developing software and the hands-on development of commercial software when dealing with real-world constraints. While the academic world embraced the structured and formal approach to software development, many practitioners in the field struggled to combine structured development models (e.g. waterfall planning) with the sometimes chaotic and entangled nature of customer requirements, prototyping and feature creep.

The above mismatch led to practitioners creating their own alternative, more flexible approaches to software development. Here the *agile manifesto* (Agile Alliance, 2001) in particular constituted a paradigm shift within the software development community. Said manifesto presents four core values that constitute the ethos of flexible development. They all echo strongly in the game development industry. These values are:

- individuals and interactions over processes and tools;
- working software over comprehensive documentation;
- customer collaboration over contract negotiation; and,
- responding to change over following a plan.

Since 2001, the software research community has gradually adhered to the practitioner guidelines established in the manifesto. Agile development is now widely considered an integral part of software development practices. The modern software engineering community is no longer looking for answers in traditional *physical* engineering. Software engineering is now

a field in itself:

The nature of software itself thereby raises the question of how much guidance one may expect from trying to emulate the development patterns of those engineering disciplines. (Mahoney, 2004, p. 17.)

Here, it is important to mention that digital game developers were perhaps particularly strongly affected by the mismatch between structured software development and real-world constraints. Game developers were early in experimenting with less structured means of software development and were using agile approaches long before the *agile manifesto* was formulated (Murphy-Hill, Zimmermann and Nagappan, 2014). However, the *agile manifesto* popularised a unifying term for these types of flexible development methods. As a result of this, game development is nowadays seen as being inextricably linked with agile development methods. Nonetheless, there are many indications that the game industry's interpretation of "agile" differs from that in other software industries (Berg Marklund et al., 2019; McKenzie, Morales Trujillo and Hoermann, 2019).

2.1.1 Research overview

One of the most ambitious research studies of game development and software engineering is Murphy-Hill, Zimmermann and Nagappan (2014). This study focuses on the differences between game development and non-game development. To a large extent, it is based on the experiences of Microsoft employees. It combines: a qualitative interview part with experienced developers; and, a survey part that tested the interview observations quantitatively on a large group of developers. The participants in the survey were "Microsoft employees who just got off public buses" (Murphy-Hill, Zimmermann and Nagappan, 2014, p. 8). The results of this study give a clear indication of differences between game development and traditional software development. The following observations from the interview part of the study were strongly confirmed in the subsequent survey part:

2.1 Software engineering

- Game developers have less clear requirements than non-game developers.
- Game developers tend to use what they perceive as an Agile process more than non-game developers.
- Creativity is valued more in game development teams.
- The ability to communicate with non-engineers is valued more on game development teams.
- Game development requires a more diverse team.
- People are more impressed by game developers' work.

(Murphy-Hill, Zimmermann and Nagappan, 2014, p. 9.)

Software engineering research involving empirical data from game companies is dominated by studies of development methods. There are several studies of methods that emphasise agile approaches. There are many observations that studios rarely follow proposed conventions (e.g. Musil et al., 2010; McKenzie, Morales Trujillo and Hoermann, 2019; Politowski et al., 2016). To some extent, the reasons for this are explored, but it is also presented as something of an enigma:

What limits the findings of the survey is the lack of data on why studios adapt or ignore agile processes. Exploring this in more depth may help to explain why studios have an unrealistic view of their agile adaptation but could also provide clues if and why agile practices were purposely modified to better meet the needs of the game development industry. (McKenzie, Morales Trujillo and Hoermann, 2019, p. 190.)

In this community, there is a solid belief that development should rest on structured and explicit methods. Many studies conclude that this is not always the case in game companies. Often, the explanation is that this is due to immaturity or lack of insight. However, informants frequently report that there are reasons behind their approach:

We've got so many specialists on the team, so the kind of planning that you usually do in Agile doesn't work quite so well... You know [specialists] are more concerned about the creative process than an engineering process. (Murphy-Hill, Zimmermann and Nagappan, 2014, p. 7.)

In a few cases, software engineering literature highlights that the lack of structure can actually be a deliberate choice by the companies:

At the same time, it is possible that this less-structured approach to game development might be, precisely, what fuels these firms to be drivers of innovation. (Pereira and Bernardes, 2018, p. 4:12.)

In addition to its interest in methods, the software engineering community also has a clear interest in testing (e.g. Kasurinen and Smolander, 2014; Murphy-Hill, Zimmermann and Nagappan, 2014; Liu et al., 2019). In this community, testing often focuses on functional requirements (Bertolino, 2007) such as behaviour being logical/correct and play being bug-free. This is frequently handled by automated tests. Several studies conclude that such approaches are less common in game development (e.g. Murphy-Hill, Zimmermann and Nagappan, 2014; Pascarella et al., 2018). Non-functional requirements (e.g. player experience) are more in focus in the user experience community, but they are also addressed in software engineering studies.

Collaboration between disciplines is addressed in a case study at a mid-sized North American game company (McDaniel, 2015; McDaniel and Daer, 2016). These two articles focus on technical communication, conflicts and constraints. Two aspects are highlighted as a source of conflicts:

Much conflict has to do with technical limitations involved with the game projects and the often chaotic circumstances in which game design unfolds. (McDaniel, 2015, p. 5.)

As one potential explanation of the tension between disciplines, McDaniel and Daer (2016) highlight the differences in expectations and goals. Another source of conflict is where the development of tools reduces the workload of one discipline at the expense of another.

The remaining software engineering studies of game development have some focus on: tools (e.g. Kasurinen, Strandén and Smolander, 2013b); management (e.g. Pereira and Bernardes, 2018); and, business aspects (e.g. Vanhala and Kasurinen, 2014). However, interest in those

2.1 Software engineering

areas is marginal in comparison to the major focus on development methods.

Research methods used in the software engineering community are predominantly quantitative, but there are also many mixed-method studies. Several studies use a grounded theory approach (e.g. Daneva, 2014; Kasurinen, 2016). The way empirical data are collected ranges from single case studies and interviews to questionnaires. There are also studies that mine open-source repositories (e.g. Pasarella et al., 2018). Finally, there are surprisingly many postmortem studies (e.g. Washburn et al., 2016; Lu, Peltonen and Nummenmaa, 2019) that analyse publicly available, game project postmortems.

Europe is well represented in this field. In particular, Finland has a large number of published studies. Jussi Kasurinen appears as an author in the majority of the Finnish studies (e.g. Kasurinen, Palacin-Silva and Vanhala, 2017; Kasurinen, Maglyas and Smolander, 2014; Kasurinen and Smolander, 2014; Kasurinen, Strandén and Smolander, 2013a; Kasurinen, Laine and Smolander, 2013).

Most software engineering research (in particular that from Finland) focuses on mobile game development. Small development studios are also well represented. AAA development has a weaker representation.

2.1.2 Recommended reading

This is a must-read for anyone interested in software engineering game development research:

- Murphy-Hill, E. et al. (2014). “Cowboys, ankle sprains, and keepers of quality: How is video game development different from software development?” In: *ICSE Conference Proceedings*. ACM, pp. 1–11. DOI: 10.1145/2568225.2568226.

For those who wish to continue reading about game development from a software engineering perspective, I recommend the following articles:

- McDaniel, R. and A. Daer (2016). “Developer discourse: Exploring technical communication practices within video game

- development”. In: *Technical Communication Quarterly*, 25 (3), pp. 155–166. DOI: 10.1080/10572252.2016.1180430.
- Washburn, M. et al. (2016). “What went right and what went wrong: An analysis of 155 postmortems from game development”. In: *ICSE Conference Proceedings*. ACM, pp. 280–289. DOI: 10.1145/2889160.2889253.
 - Kasurinen, J. et al. (2017). “What concerns game developers? A study on game development processes, sustainability and metrics”. In: *WETSoM Workshop Proceedings*. IEEE, pp. 15–21. DOI: 10.1109/WETSoM.2017.3.
 - Koutonen, J. and M. Leppänen (2013). “How are agile methods and practices deployed in video game development? A survey into Finnish game studios”. In: *XP Conference Proceedings*. Springer, pp. 135–149. DOI: 10.1007/978-3-642-38314-4_10.
 - Wang, A. I. and N. Nordmark (2015). “Software architectures and the creative processes in game development”. In: *ICEC Conference Proceedings*. Springer, pp. 272–285. DOI: 10.1007/978-3-319-24589-8_21.

2.2 Information systems

Information systems (IS) development has clear overlaps with software engineering. Both fields focus on technology and computers and how to best approach the development of software systems. IS¹ has a greater focus on organisational aspects and is more closely akin to management and business studies:

information systems deals with systems for delivering information and communications services in an organization and the activities and management of the information systems function in planning, designing, developing, implementing, and operating the systems and providing services. (Davis, 2000, p. 62)

When computerised transaction systems were originally introduced in companies and organisations, they were operated by experts. When they became increasingly common, more groups and employees with no formal training as computer operators started to use them. This presented a lot of challenges for the: developers of such systems; organisations that deployed them; and, end users who had to operate them.

With its greater focus on organisational aspects and users, the IS field has, compared to the software engineering field, a stronger tradition of including research based on a constructivism paradigm. Nonetheless, positivism is also represented in the IS community.

Information system experts focus on developing systems for a receiving organisation. Depicted in 2.1, this situation is the norm for IS researchers. The combination of skills needed to develop an information system is captured in *IS development methods*. Iivari, Hirschheim and Klein (2004) identify a corpus of IS development knowledge and suggest that an IS expert should have the following competencies:

- IS development process knowledge. This covers tools, techniques, methods and approaches used in systems development. It is

¹ Different terms are used to characterise this field (e.g. *management information systems*, *information management* or *management of information systems*).

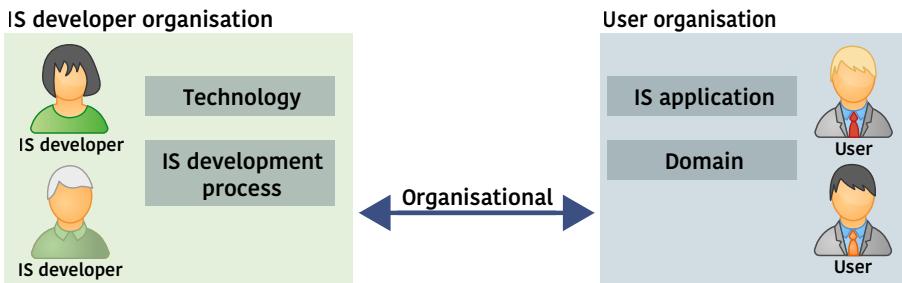


Figure 2.1: A typical IS development scenario.

considered to be a core competence for IS development experts.

- IS application knowledge. This covers an understanding of typical IT applications and their use. It too is considered to be a core competence for IS development experts.
- Application domain knowledge. This relates to the target domain for the system and is mainly assumed to be a competence provided by the target organisation.
- Technology knowledge. This covers knowledge of different types of hardware and software such as computers and operating systems.
- Organisational knowledge. This covers social, organisational and human elements as well as economic processes.

It is clear from the characterisation of this body of knowledge that there is a strong focus on organisational aspects. The assumed receiver of an information system is an organisation. This is rarely the case for games. Figure 2.2 shows my understanding of how a typical game development scenario interfaces with the concept of a corpus of IS development knowledge. With games, the organisational aspect is not very central. Instead, there is a close relationship between the developers and the users (i.e. the *players*). Players do not use games for utilitarian purposes or as part of their paid job. Their main aim is recreation. The development team comprises not only IS developers, but also a number of other professionals. This implies that the organisational dimension is mainly a concern within the development team. While some team members may

2.2 Information systems

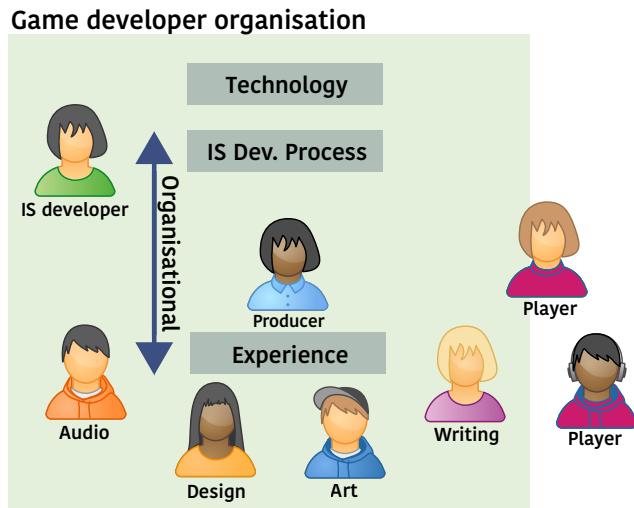


Figure 2.2: A typical game development scenario.

be focused on the IS development process and technological elements, these may not be a relevant or important focus area for other members.

2.2.1 Research overview

The IS community focuses less on games than does the software engineering community. However, via its focus on organisational aspects, its perspective of game development is somewhat broader. The analysis presented below covers research published in forums explicitly focused on information systems, informatics and similar terms. Topics covered in these studies range from development methods (e.g. Weerd, Weerd and Brinkkemper, 2007; Stacey and Nandhakumar, 2008; Amanatiadou and Weerd, 2009), documentation (e.g. Stacey and Nandhakumar, 2009; Alves, Ramalho and Damasceno, 2007) and management (e.g. Petrillo et al., 2009; Schmalz, Finn and Taylor, 2014) to innovation (e.g. Freeman et al., 2019).

Most studies in the IS community acknowledge differences between game development and traditional information system development. The

solution proposed for handling these differences is to always adopt the approaches and techniques available in the targeted community: “Careful risk management is still required to ensure projects meet their success targets” (Schmalz, Finn and Taylor, 2014, p. 4334). This usually entails introducing some relaxation of structured methods and inviting “unstructured” professionals from other domains:

A particular problem in game development is the integration of disciplines from non-engineering domains like graphic design, since their unstructured, opportunistic workflow differs considerably from the conservative approaches in engineering. (Musil et al., 2010, p. 88.)

In an analysis of postmortems, Petrillo et al. (2009) conclude that all problems found in the traditional software industry can also be found in the game industry. However, they do not demonstrate the reverse, i.e. that all problems in game development can be found in software development.

With case studies and interviews dominating, methods used in IS research resemble those used in software engineering. There are slightly more qualitative studies in the IS community. Regional representation is relatively balanced between Asia, Europe and America. Singapore is represented via several studies by Patrick Stacey and Joe Nandhakumar.

Studies of mobile game development and smaller, independent studios dominate IS research (as was also the case in software engineering).

2.2.2 Recommended reading

This is a must-read for anyone interested in IS game development research:

- Stacey, P. and J. Nandhakumar (2009). “A temporal perspective of the computer game development process”. In: *Information Systems Journal*, 19 (5), pp. 479–497. DOI: 10.1111/j.1365-2575.2007.00273.x.

For those who wish to continue reading about game development from

2.2 Information systems

an IS perspective, I recommend the following articles:

- Schmalz, M. et al. (2014). “Risk management in video game development projects”. In: *HICSS Conference Proceedings*, pp. 4325–4334. DOI: 10.1109/HICSS.2014.534.
- Weerd, I. van de et al. (2007). “Developing a reference method for game production by method comparison”. In: *ME Conference Proceedings*. Springer, pp. 313–327. DOI: 10.1007/978-0-387-73947-2_24.
- Stacey, P. and J. Nandhakumar (2008). “Opening up to agile games development”. In: *Communications of the ACM*, 51 (12), pp. 143–146. DOI: 10.1145/1409360.1409387.
- Petrillo, F. et al. (2009). “What went wrong? A survey of problems in game development”. In: *Computers in Entertainment*, 7 (1), DOI: 10.1145/1486508.1486521.

2.3 User experience

While software engineering and information systems focus on technology and organisation, the user experience area has a clear focus on the individual. Said focus has its roots in design studies and the design of non-digital interaction. When digital interfaces started to be common, theories and methods from cognitive science, design and ergonomics were applied to this new field. The introduction of graphical user interfaces to software systems in the late '70s was an important starting point for human-oriented computing. ACM founded a Special Interest Group on Computer-Human Interaction (SIGCHI) in 1982.

For many years, the term human-computer-interaction (HCI) dominated. In this field, there was a strong focus on utilitarian software and how to create efficient user interfaces, i.e. *usability*. When the World Wide Web was growing in the '90s, this received a lot of attention from the HCI community. Computer supported cooperative work (CSCW) and how to create systems that supported work collaborations between geographically separated humans became a focus area. Very little attention was paid to the play aspects of computing (utility remained the focus).

From the early days of HCI, the focus on designing interfaces and evaluating them has always been split.

As regards evaluating, the community has been strongly influenced by quantitative, formative evaluation methodologies such as laboratory-based experiments using metrics that are believed to give robust, objective and reliable results. These led to the rigorous (and slow) evaluation of designs. Designing was also guided by rigorous methodologies strongly influenced by engineering and ergonomics traditions. Consequently, the design process became quite rigid and the resulting interfaces were conservative. This primarily influenced utilitarian software.

With a shift away from utilitarian aspects towards the human experience, the focus on *user experience* started to grow by the end of the '90s (Pagulayan et al., 2018a).

User experience can be defined as: “A person’s perceptions and

2.3 User experience

responses that result from the use or anticipated use of a product, system or service” (Law et al., 2009, p. 727). This is a shift of focus from utilitarian aspects towards the human experience. This led to an awareness that “design-as-engineering” (Wright, Blythe and McCarthy, 2005, p. 1) had to change. In other words, design should not be seen purely as an engineering exercise; perspectives from other disciplines (e.g. arts and humanities) were also needed. This philosophy matched the focus in game development well. Game companies that had always created interfaces for non-utilitarian purposes did not know or care much about HCI principles (Jørgensen, 2004). When the internet reached homes, the game industry started to develop systems that supported massive multiplayer games, something that can be characterised as computer supported cooperative play (Wadley et al., 2003).

These developments were made without interest in CSCW results. Eventually, the HCI community started to acknowledge the achievements of game developers (Dyck et al., 2003; Jørgensen, 2004). Over the past 15 years, user experience research has become the area that is probably best integrated with game development. Game user experience (GUX) has evolved as a subfield with its own identity². This integration is visible in, for example, the number of GUX researchers employed by game companies.

A possible explanation to the integration of researchers in GUX departments is that game evaluation can, and often should, be externalised from production. This has paved the way for specialised professionals to enter game companies (frequently as consultants). These GUX specialists do not have to be integrated into the main development team. They can operate relatively independently with tight connections to only a few designers and producers. This model has contributed to a successful integration of GUX researchers into game companies.

² The terms *GUX* and *Game User Research* (GUR) are used almost interchangeably. Based on the fundamental differences between playing a game and using utilitarian software, there have also been attempts to promote the term *Player Experience* (PX) (Nacke and Drachen, 2011). Nonetheless, the term PX appears not to be widespread. *GUX* is used throughout this book.

As a consequence, there are research publications (see, for example, Azadvar and Canossa, 2018) where all authors are affiliated to a game company. This is rarely seen in other areas.

It should be noted that testing in game production is split between software testing, quality assurance (QA) testing and GUX. Software testing is primarily the concern of programmers and relates to aspects such as: unit, system and integration testing; compatibility testing; performance analysis; and, profiling, etc. QA can be said to be between software testing and GUX:

[QA] is essentially functional testing rather than usability or experiential testing. The QA team are keen gamers with a good understanding of the market and what to expect from a high quality game. (McAllister and White, 2015, p. 15.)

Compared to the research focus on GUX, that on QA is minimal. The only focused study, in my material, is one by Bulut (2015). This presents a politico-economic analysis of QA game workers. QA is commonly mentioned as an important activity in many articles, but very few details are given. There are no sharp boundaries between the different types of game testing and, in smaller studios, there is certainly an overlap between QA and GUX.

Another activity related to user experience and testing is game analytics. One part of game analytics is targeted at business functions and is used to support *business intelligence*. Another part of game analytics is used to support *design intelligence*:

Business intelligence, as the name suggests, is the practice of using customer data to make business decisions that, typically, are focused on optimizing revenue. The data may be used to understand what happened in the past (e.g., daily average users), the present (e.g., real-time usage and purchase data), or the future (e.g., predicting how a new product will sell). Design intelligence, on the other hand, is the use of data to optimize the experience of

2.3 User experience

a product or service while it is in development. (Pagulayan et al., 2018a, p. 320.)

Although design intelligence is that part of analytics most closely linked to GUX, design and business intelligence are related because there are clear ties between business and design decisions. Analytics can also be used to support QA aspects. As illustrated in figure 1.2, analytics falls between software development, management and publishing.

The distinguished scholar Anders Drachen has contributed to both GUX and game analytics. For example, he is a co-editor of one of the first books addressing GUX (Drachen, Mirza-Babaei and Nacke, 2018) as well as of a book addressing game analytics (El-Nasr, Drachen and Canossa, 2016). When discussing the dual role of analytics, Drachen (2015) distinguishes between players and customers. This provides an intuitive embodiment of the differences between the design and business perspectives.

2.3.1 Research overview

AAA game companies are strongly represented in GUX research. This is apparent in, for example, the above-mentioned book by Drachen, Mirza-Babaei and Nacke (2018). The book has contributions from several leading AAA companies such as Electronic Arts (e.g. Zammitto, 2018) and Sony (e.g. Sangin, 2018). This reflects a close collaboration between academia and industry in the GUX field, something missing in most other areas related to game development. GUX practice at AAA companies is communicated quite openly (by the practitioners themselves) in research forums.

A deep insight into industrial GUX practice at a large AAA company is presented by Pagulayan et al. (2018a). They report experiences from their GUX practice at Microsoft Studios. Here, they served as a centralised unit that was not directly involved in design. They summarise their role as follows:

At a very general level, the role of a games researcher should be to

provide an unbiased feedback loop to game designers. (Pagulayan et al., 2018a, p. 306.)

Pagulayan et al. (2018a) highlight how important it is for the GUX team to keep a balance between independence and integration with the development team. The authors stress the value of being located in a centralised unit that supports many development teams. This is said to:

... help researchers resist the groupthink that often happens when all the game development team members are completely immersed in game development on a single title. (Pagulayan et al., 2018a, p. 307.)

Such separation may not be possible in small organisations, but the need for GUX professionals to stay emotionally detached from development may still be important. GUX practices at small studios are addressed in several studies (e.g. Moosajee and Mirza-Babaei, 2016; Dorell and Berg Marklund, 2018). Moosajee and Mirza-Babaei (2016) present a study focusing on first time user experience in three different independent games. One of their conclusions is that “The [GUX] approach needs to fit within an indie timeline, budget, resources, and tools” (Moosajee and Mirza-Babaei, 2016, p. 3164).

Despite the tight integration between game development and GUX research, there is still a lot of research that has little or no industrial connection. This gap is acknowledged in a study by McAllister and White (2015):

One reason for the lack of tailored techniques which could be applicable to all stages of game development is that the game development process itself is not known in detail to the HCI community. (McAllister and White, 2015, p. 14.)

As mentioned above, the user experience community has a dual tradition of both designing interaction and evaluating existing solutions. GUX research is heavily dominated by the latter. Very few studies report on how, for example, the interaction design is created in game production. Most studies focus on user tests and analyses of gameplay. A separation between developers and GUX personnel is common in the industry.

2.3 User experience

Zammitto (2018) presents three organisational models for GUX in companies, namely, decentralised, centralised and hybrid. In a centralised model, GUX personnel form a unit of their own (similar to a consultancy) and serve several development teams. In a decentralised model, the GUX personnel are typically part of a development team. Each model has its strengths and weaknesses, but the decentralised model has the strongest potential for involving GUX in development and design. It is interesting to note that the UX summit at the Game Developers Conference (see section 7.1) includes both UX design and evaluation as topics of interest. The GUX research community does not appear to have the same dual focus.

One aspect of GUX testing is the need to identify and reach a target group. Traditionally, with developers creating games for themselves, this has not been a major concern in the game industry. However, as the market and types of games have expanded, this has changed:

Now with a broader market and games that are particularly intended to be played by less experienced players, the distance between the developers and market means that fewer assumptions can be made and more attention has to be paid to testing.
(McAllister and White, 2015, p. 25.)

This touches on: diversity and representation in the development team; and, game accessibility. Even if GUX testing can support an understanding of different target groups, representation in the development team would enhance inclusion. Game accessibility is an area that has close links to GUX and interaction design (Westin, Brusk and Engström, 2020).

The use of analytics in GUX is reported in several studies. There are studies (e.g. Makarovych et al., 2018; Hullett et al., 2012) where analytics is used to analyse player behaviour in specific games. Hullett et al. (2012) show how analyses of player data revealed that many game features in *Project Gotham Racing 4* were often not used. This had repercussions for future projects:

From the patterns in the data we made recommendations for future

development. Many rarely utilized options could be removed with no negative impact on players. (Hullett et al., 2012, p. 96.)

Different genres (e.g. single player vs. multiplayer) pose different challenges. Drachen, Canossa and Sørensen (2013) note that persistent massive multiplayer games are different in that:

A substantial focus is on the application of gameplay metrics analysis and synthesis to tune game design on a running basis...
(Drachen, Canossa and Sørensen, 2013, p. 316.)

The continuous development of many games makes analytics an important part of the feedback loop from players to both designers and GUX researchers. The quantitative metrics from analytics complement other, qualitative methods used in GUX.

A few articles in the GUX field focus not on players and games, but on developers and the tools they use to design games and to collaborate (e.g. Freeman et al., 2020; Nelson and Mateas, 2009). In general, there is comparatively little research involving studies of tools in game production (Toftedahl and Engström, 2019). User experience and usability aspects of such tools are no exceptions here.

Case studies dominate the methods used in GUX research. Without adopting any explicit method, many articles detail researchers' practice. To some extent, these could be regarded as autoethnographic. The analytics studies are dominated by quantitative single-case studies. Western game development is well represented in GUX research. North American companies preponderate.

2.3.2 Recommended reading

This is a must-read for anyone interested in GUX research:

- Pagulayan, R. J. et al. (2018a). "Applied user research in games". In: *The Wiley Handbook of Human Computer Interaction, Volume 1*. Ed. by K. L. Norman and J. Kirakowski. John Wiley & Sons, pp. 299–346. DOI: 10.1002/9781118976005.ch16.

2.3 User experience

For those who wish to continue reading about game development from a user experience perspective, I recommend the following articles:

- Zammitto, V. (2018). “Games user research as part of the development process in the game industry: Challenges and best practices”. In: *Games User Research*. Ed. by A. Drachen et al. Oxford University Press, pp. 15–30. DOI: 10.1093/oso/9780198794844.003.0002.
- McAllister, G. and G. R. White (2015). “Video game development and user experience”. In: *Game User Experience Evaluation*. Ed. by R. Bernhaupt. Springer, pp. 11–35. DOI: 10.1007/978-3-319-15985-0_2.
- Drachen, A. et al. (2013). “Gameplay metrics in game user research: Examples from the trenches”. In: *Game Analytics*. Ed. by M. S. El-Nasr et al. Springer, pp. 285–319. DOI: 10.1007/978-1-4471-4769-5_14.
- Dorell, J. and B. Berg Marklund (2018). “Starting from scratch: Pragmatic and scalable guidelines to impactful games user research”. In: *Games User Research*. Ed. by A. Drachen et al. Oxford University Press, pp. 431–452. DOI: 10.1093/oso/9780198794844.003.0025.
- Hullett, K. et al. (2012). “Empirical analysis of user data in game software development: The story of Project Gotham Racing 4”. In: *ESEM Conference Proceedings*. ACM, pp. 89–98. DOI: 10.1145/2372251.2372265.
- Drachen, A. (2015). “Behavioral telemetry in games user research”. In: *Game User Experience Evaluation*. Ed. by R. Bernhaupt. Springer, pp. 135–165. DOI: 10.1007/978-3-319-15985-0_7.

The anthology presented by Drachen, Mirza-Babaei and Nacke (2018) contains many contributions from researchers associated with large game companies. This is a good starting point for studies of GUX:

- Drachen, A. et al. (2018). *Games User Research*. Oxford University Press. ISBN: 978-0-19-879484-4. DOI: 10.1093/oso/9780198794844.001.0001.

2.4 Other software areas related to games

In addition to the areas highlighted in previous sections, there are many more computer science and informatics specialisations relevant to game development. Said specialisations cover game aspects such as artificial intelligence, computer architecture, databases, networking, programming languages, open-source software and computer graphics. These fields rarely acknowledge the particular game development focus prevalent in industry.

2.4.1 Artificial intelligence

The game industry is highly interested in artificial intelligence (AI) and the AI community has a strong interest in games. Thus, it is surprising that there is so little research looking at AI from a game development perspective. Initially focused on gameplay elements, game AI has grown to play a role in many aspects of game production. Riedl and Zook (2013) identify three roles for Game AI:

- AI as actor. This can, for example, be to create non-player character (NPC) behaviour.
- AI as designer. This can, for example, be to generate game levels procedurally.
- AI as producer. This can, for example, be to support community management and to detect abusive behaviour.

For a long time, game AI was considered to be of little interest to AI research:

AI academics and game engineers once found themselves separated by a sophistication gap: high-potential academic techniques on one side, and scripting (and other scalable, practical engineering techniques) on the other. (Kolen et al., 2018, p. 7680.)

This statement was made in a recent article by representatives from the central AI team at Electronic Arts. Arguing that the gap is shrinking, they highlight procedural content generation, player prediction and decision

2.4 Other software areas related to games

support for development planning. Hence, AI in game companies is not limited to AI as actor aspects and it is also not only a concern for programmers: “Consequently artists, engineers, marketers, scientists, and management deal with a wide range of AI problems” (Kolen et al., 2018, p. 7681).

The relevance of AI to games is undoubtedly high. There is a clear lack of studies that approach applications of AI in a development context.

2.4.2 Computer graphics

Computer graphics is another software area that has been strongly associated with games. It was also one of the first academic communities to show an interest in applied game development (Rhyne, 2000). As with AI research, there are very few articles studying computer graphics in a game development context. Most often, the only requirement extracted from game production is the need to render graphics in real time (e.g. at 60 frames per second). Based on my literature searches, a recent article by Statham (2020) is one of the few exceptions to this. Statham’s study presents how a specific modelling technique has been adopted in game production. Production time is highlighted as an important aspect that has to be borne in mind.

2.4.3 Hardware

As stated in the introduction, hardware has played a central role in digital game development. For most game studios, hardware development is outside their control. The big console developers Sony, Nintendo and Microsoft are exceptions in that they control both software and hardware for their consoles. There is surprisingly little literature studying the processes behind the development of console hardware and the very many accessories that have been produced in the past. The latter are particularly interesting because they are often tightly linked to game design. Examples of such accessories are the: *NES Duck hunt Zapper*; *Donkey Konga controller*; *Guitar Hero controllers*; *Wii Balance Board*; *GameTrak*; *Eye Toy camera*; *Buzz! buzzers*; and, *Xbox Kinect*. The lifetime of most of these accessories is notably short (peripherals come

and go). It is hard to say if this is as per the companies' business plans or if there is a fundamental challenge in trying to create sustainable variations in game controllers. There are also no studies on how game developers are involved in the planning and development of peripherals. The possibility of creating unique interfaces for a game must have major implications in the game design processes.

Another dimension of hardware is the technical characteristics of the computers used to execute games. Developers have always spent a lot of energy optimising games to deliver as much as possible from the limited physical capacity of the hardware. To do this, they need to have a detailed understanding of all technical components. Although there are studies addressing this aspect of game development (e.g. Russel et al., 2011), these technical characteristics are mostly studied in abstract terms without specific application areas in focus.

2.4.4 Internationalisation and localisation

Internationalisation and localisation is the process of making a product accessible outside a domestic market. Localisation is making a product linguistically and culturally appropriate for a specific market and internationalisation is preparing a product so that localisation support can be provided. Both these activities are relevant for most software. However, games are very often rich with culturally dependent content that requires extensive adaptation. Graphical representation, game design, regulations and available technical infrastructure may all have to be addressed.

Internationalisation and localisation has received some interest in a gaming context. Based on a case study and previously suggested methods, Weerd, Weerd and Brinkkemper (2007) highlight localisation as an important step in their proposed “super-method” for game development. They note that:

There exist quite some differences in elements of the game production domain between the various sources. For example, the

2.4 Other software areas related to games

importance of localization of a game was stressed in some theories, while the localization process was completely omitted in others. (Weerd, Weerd and Brinkkemper, 2007, p. 324.)

Using a number of case studies, Toftedahl, Backlund and Engström (2018) analyse game localisation from an indie game developer perspective. Recent developments have made self-publishing on a global market possible. Although this enables small independent studios to reach a large audience, it also presents them with the challenge of handling the localisation process.

2.4.5 Recommended reading

Amongst the articles highlighted in this section, this is a must-read:

- Kolen, J. F. et al. (2018). “Horizontal scaling with a framework for providing AI solutions within a game company”. In: *IAAI Conference Proceedings*. AAAI.

The following articles are also recommended:

- Russel, G. et al. (2011). “The impact of diverse memory architectures on multicore consumer software: An industrial perspective from the video games domain”. In: *MSPC Conference Proceedings*, pp. 37–42. DOI: 10.1145/1988915.1988925.
- Statham, N. (2020). “Use of photogrammetry in video games: A historical overview”. In: *Games and Culture*, 15 (3), pp. 289–307. DOI: 10.1177/1555412018786415.

2.5 Forums for game research in software areas

A number of journals and conferences in the software field publish research on game development. This section highlights those that have featured most frequently in the reviews carried out for this book.

Software development communities have a strong tradition of publishing research in conference proceedings. In most other disciplines in this book, journals have a much stronger position. Of the journals that have a software development focus, only a few target games. In my materials, *Computers in Entertainment* (ACM, 2020) is the most frequently cited of these journals. However, it came to an end in 2018. The similarly named *Entertainment Computing* is still published. It targets:

... innovative research ideas, emerging technologies, empirical investigations, state-of-the-art methods and tools in all aspects of digital entertainment, new media, entertainment computing, gaming, robotics, toys and applications among researchers, engineers, social scientists, artists and practitioners. (Elsevier, 2020.)

This reflects the broad scope of the journal, something it shares with many journals and conferences focused on games. Consequently, assigning them to a single discipline is hard. Nonetheless, the use of the word *computing* in the name is an indication of a software focus. Similarly, a focus on game technology would seem explicit in *International Journal of Computer Games Technology* (Hindawi, 2020). However, the articles published in this journal seem to have a somewhat broader scope and include studies with little or no focus on technology. The final journal highlighted in this section is *The Computer Games Journal* (Springer, 2020), which: “aims to encourage and promote research into games development and the games industry as a whole.” (Springer, 2020) This journal is unique in its explicit focus on game development and the ambition that its research should be relevant to practitioners.

There are numerous conferences in the software field that include papers

2.5 Forums for game research in software areas

with content related to game development. However, most of these do not have an explicit focus on games. In the IS field, for example, there have been many papers published in the *Hawaii International Conference on System Sciences*. *The International Conference on Software Engineering* and *the International Requirements Engineering Conference* are other examples of forums that have received many papers focused on games. Finland's *MindTrek Academic Conference* is an interesting regional conference that has showcased much game-oriented research.

There are also some explicit game conferences that have a strong software development focus. The broadest of these is *Foundations of Digital Games* (FDG). This has its roots in Microsoft but, since 2009, it has been managed by a non-profit organisation. FDG proceedings are published by the *Association of Computing Machinery* (ACM). The *IEEE Conference on Games* (CoG) is another broad conference with a clear technical focus. This has its origins in an AI community, but has widened its scope over the past few years. In addition to these broad game conferences, there are also those that focus on specific aspects. Examples include *Computer-Human Interaction Play* (CHI Play), *ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games* (I3D) and *Artificial Intelligence and Interactive Digital Entertainment* (AIIDE).



3. Game studies

The game studies community was established in the early '00s and is strongly influenced by media studies. The main focus has been on studies of games, players and playing as a social activity. Although some scholars argue that game studies should embrace all aspects of digital games, this was not taken as law when the field was established. In the first issue of the *Game Studies* journal, Espen Aarseth stated: "We all enter this field from somewhere else, from anthropology, sociology, narratology, semiotics, film studies, etc." (Aarseth, 2001). The examples he gave do not include any fields related to mathematics, engineering or computer science. It is clear that, at that time, game studies did not embrace the full KCC (figure 1.1). This is perfectly acceptable. Academic discussions can be very shallow if participants from all disciplines follow them. However, it must not be believed that game studies is the only academic community relevant to games.

Most research in the game studies community is devoted to analyses of games, players and the surrounding culture (figure 3.1). Analysing the motivations of, and social interactions between, players in massive multiplayer online games is an example. The mission statement of the *Game Studies* journal reveals one of the community's central focuses: "Our primary focus is aesthetic, cultural and communicative aspects

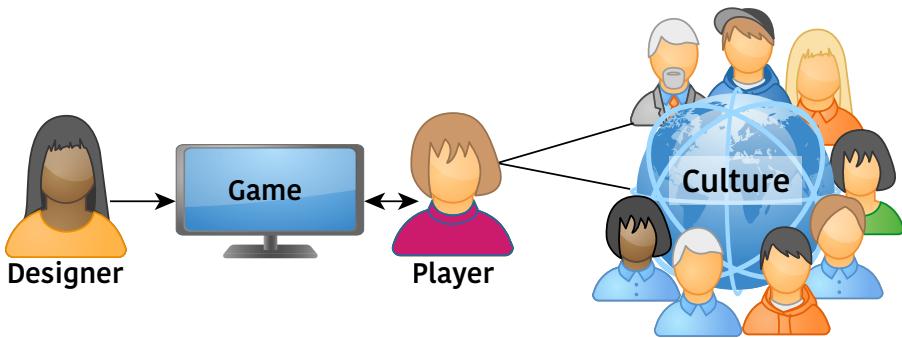


Figure 3.1: The focus points in the game studies community. Development is mainly studied as design. The emphasis is on studies of games, players and the surrounding culture.

of computer games" (gamestudies.org, 2020). Clearly, this does not emphasise game development. The development process behind studied games has received very little attention in the wider context of game research (Martin, 2018). There has been some interest in game design as an elevated activity, but very few studies include the full complexity of game production. In the early years of game studies, Mateas and Stern (2005) argued the importance of applied game design, but this has not greatly influenced the community.

The reason for the game studies community's lack of interest in game development may possibly be found in the traditions of the neighbouring fields of literature studies and film studies. In literature, there has been a strong trend of ignoring author ambitions and focusing on the text and readers' interpretations. Following a text by Barthes (1977), this school of thought has been referred to as "the death of the author". It is argued that a focus on the author (who is not part of the narrated universe) clouds analysis of the experience and understanding of characters and story:

To give a text an Author is to impose a limit on that text, to furnish it with a final signified, to close the writing. (Barthes, 1977, p. 147.)

This perspective of the relationship between the creator and the created

piece can easily be applied to all creative work. It is easy to see why it has been applied to games. However, for this book's purposes, it is a very fruitless perspective. Fortunately, there are game studies that go against Barthes' view:

Bourdieu's reference to field, by which he meant the conditions under which an individual produces a text, is particularly important to digital games. These conditions inform and influence how attitudes are incorporated in texts. Solely studying the moral gameplay without including the social and historical forces that inform the design (context of design) and the perceptions of those who create the texts (designers' perceptions) misses the cruciality of why moral gameplay contains those choices. (Smale, Kors and Sandoval, 2019, pp. 391-392.)

It is interesting to note that, in this case too, argument is based on text theories. This perspective greatly influences the game studies community. The strong focus on *the* designer may very well be rooted in this strong author-text perspective.

Although mainstream game studies have not concerned themselves with game development, there are some interesting *sideline exceptions*. In the remainder of this chapter, areas where scholars have studied game development practice are highlighted. The first section presents studies that address the development process as a unified activity. “Production studies” or “studio studies” are terms used in many of these works. The second section highlights studies that focus specifically on game design and ideation. Largely because these studies isolate ideation from the other parts of development, they are not included under production studies. The final section presents studies focusing on other specific dimensions of game development.

3.1 Game production studies

Game production studies have their roots in production studies in other media formats such as television and film. One focus of such studies is understanding how culture is created under the constraints imposed by the system in which it is produced (Mayer, Banks and Caldwell, 2009). In gaining this understanding, a social science and humanities tradition (which highlights collection of data from practice) is adopted:

Production studies gather empirical data about production: the complexity of routines and rituals, the routines of seemingly complex processes, the economic and political forces that shape roles, technologies, and the distribution of resources according to cultural and demographic differences. (Mayer, Banks and Caldwell, 2009, p. 4.)

Creativity has traditionally been studied as an individual cognitive process or, focused on *creative regions* (e.g. Silicon Valley), as a societal phenomenon. As the name intimates, *studio studies* focuses on the creative studio. This field is in its making and there are very few studies that use the term. A search in Scopus gave 17 hits, most of them from the last decade. Farias and Wilkie (2016b) present an anthology focusing on studio studies and, in their introduction, present something which could be seen as a programme statement for this new field:

With Studio Studies, our purpose, then, is to change the very register through which creativity is understood by bringing into focus creation processes understood as processes of both inventing and making cultural artefacts. (Farias and Wilkie, 2016a, p. 4.)

The emphasis on the production process is something that is traditionally missing in the game studies community. In research focused on games as software, the invention process is traditionally missing. This book advocates a philosophy that can be said to have a *multifocus* which includes production and invention. I hope that such an approach will attract more interest in the years to come.

3.1 Game production studies

3.1.1 Research overview

In the early 2000s, at an Australian PC game developer, John A.L. Banks conducted one of the first ethnographic game production studies (Banks, 2005). This focused on player cocreation and how player participation in development impacted on the development process.

Game studies scholar Casey O'Donnell has made several important contributions to production studies. His research is based on ethnographic studies of game development in the USA and India. Besides publishing several articles, he also authored the book *Developer's Dilemma* (O'Donnell, 2014). O'Donnell has a deep understanding of game production and highlights the importance of the tools used to create games. This is done with a level of detail and insight rarely seen in other studies:

The 3D models, created with 3D Studio Max (or just 'Max'), were exported using the proprietary set of software tools, often called a 'tool-chain' by game developers. These tools, known as Alchemy, performed customizations and assorted automations to each model being exported. (O'Donnell, 2011, p. 279.)

The role of tools in game production has been highlighted in a few other studies (e.g. Consalvo and Paul, 2018; Whitson, 2018; Toftedahl and Engström, 2019).

A few game focused articles (e.g. Smale, Kors and Sandovar, 2019; Tyni, 2020; Roessel and Katzenbach, 2020) are explicitly framed as production studies. For example, via an interview with 20 German developers, Roessel and Katzenbach (2020) analyse how game developers handle the balance between creating original ideas and copying existing games. The authors included designers, artists, programmers and producers in the interviews. Their study shows that there is strong acceptance of using existing games as an inspiration, but that slight adjustments are needed before use is possible. Developers are generally not in favour of stricter copyright protection rules for games.

In the game studies community, Jennifer R Whitson is the scholar who

has most clearly highlighted the importance of studio studies (Whitson, 2020; Whitson, 2019; Whitson, 2018). Collaterally, she analyses the role tools play in the collaboration between different disciplines (Whitson, 2018). This is done in a case study where ten student interns at a large game company set out to build a game in ten weeks. Whitson concludes that:

Rather than a mutely obedient tool, software exerts agency of its own and is seen to exhibit magical, even agential properties during game development. (Whitson, 2018, p. 2328.)

Based on this case study Whitson analyses the role studio studies plays for game scholars (Whitson, 2020). She explicitly acknowledges the challenges that scholars who have not developed games themselves face when having to act in a context where students are educated to become developers:

We enter the field by writing about games and gamers, but as a condition of employment, we are increasingly asked to become ‘theorist-practitioners’ and teach others to make games. (Whitson, 2020, p. 268.)

Given the large number of game development programmes offered by universities (mainly in the west), this is an important observation. Many game scholars have a background in game analysis, but this does not automatically transfer to an understanding of how to create games.

In another study, Whitson, Simon and Parker (2018) present the results of a large interview study with indie developers. The authors highlight that these developers’ motivations differ from those of other software start-ups. Predominantly, indies do not have the goal of growing in size and profitability, but of continuing to develop games. However, to do this they need to spend time on activities related to planning, finance, publishing and community support. The authors refer to this as *not development work*. Whitson, Simon and Parker (2018) argue that indie publishers need to include the producer role in their teams and that it is not sufficient to simply expect developers to turn into entrepreneurs:

3.1 Game production studies

The issue with replacing the ‘missing producer’ with the ‘indie entrepreneur’ is that entrepreneurship frameworks are too narrowly equated to marketing and biz dev, and often exist in tension with developers’ own goals and conceptions of ‘good work’. In other words, in embracing cultural entrepreneurship, developers must become the very things they rejected in the mainstream industry. (Whitson, Simon and Parker, 2018, p. 9.)

Another recent studio study is Jørgensen (2019), which studies the operation of a Norwegian start-up. This studio had little experience of game development and was funded via public funds. It was concluded that production partly failed because: “Challenges were related to lack of experience, and difficulties managing time and resources” (Jørgensen, 2019, p. 675).

A final example of an explicit studio study is Ash (2016), which presents an ethnographic study of a British console and PC game developer. The study uses the theoretical concepts of *spheres* and *atmospheres*. It identifies servers, headphones and screens as objects that constitute spheres:

Objects that appear on screens or sounds pumped through headphones can contribute to broader atmospheres in ways that cut across distinctions between the digital space of the game or software or screen and the physical space of the studio in which these objects are located. (Ash, 2016, p. 102.)

These observations may appear philosophical and hard to relate to from a development perspective. However, the study is not oriented towards applied development. It is more likely targeted at the basic research community.

In total, there are very few game production studies. The majority of these studies have been conducted in northern America and northern Europe. Methods applied in production studies are mainly ethnographic with interviews and observations of case companies. Both AAA and smaller companies are represented in these studies.

3.1.2 Recommended reading

This is a must-read for anyone interested in research addressing game production studies:

- Whitson, J. R. (2020). “What can we learn from studio studies ethnographies?: A ‘messy’ account of game development materiality, learning, and expertise”. In: *Games and Culture*, 15 (3), pp. 266–288. DOI: 10.1177/1555412018783320.

For those who wish to continue reading about game production studies, I recommend the following articles:

- O'Donnell, C. (2009). “The everyday lives of video game developers: Experimentally understanding underlying systems/structures”. In: *Transformative Works and Cultures*, 2 (1), pp. 1–11. DOI: 10.3983/twc.2009.073.
- Whitson, J. R. et al. (2018). “The missing producer: Rethinking indie cultural production in terms of entrepreneurship, relational labour, and sustainability”. In: *European Journal of Cultural Studies*, pp. 1–22. DOI: 10.1177/1367549418810082.
- Roessel, L. van and C. Katzenbach (2020). “Navigating the grey area: Game production between inspiration and imitation”. In: *Convergence*, 26 (2), pp. 402–420. DOI: 10.1177/1354856518786593.
- Smale, S. de et al. (2019). “The case of This War of Mine: A production studies perspective on moral game design”. In: *Games and Culture*, 14 (4), pp. 387–409. DOI: 10.1177/1555412017725996.
- Jørgensen, K. (2019). “Newcomers in a global industry: Challenges of a Norwegian game company”. In: *Games and Culture*, 14 (6), pp. 660–679. DOI: 10.1177/1555412017723265.
- Banks, J. (2005). “Opening the Production Pipeline: Unruly Creators”. In: *DiGRA Conference Proceedings*. DiGRA.

3.2 Game design

This section addresses studies that view game design as an elevated activity. Said view differs from that of studio studies where:

The notion of distributed creation emphasizes creativity as a socio-material and collective process, in which no single actor holds all the cards. (Farias and Wilkie, 2016a, p. 5.)

The studies highlighted in this section focus more specifically on game design and the role of the game designer. Before continuing, the concept of game design needs to be examined more closely. The term *design* is overloaded with connotations and different meanings are used in different contexts and regions.

The original Latin source of *design* means *to designate* (to give shape). Design has long been studied in architecture and engineering. There are many similarities between game design and design of other artefacts. The types of challenge faced in designing, for example, a public space resemble those in designing a virtual space in a multiplayer game (Álvarez and Duarte, 2018). Certain design methods (e.g. participatory) used by design scholars can also be used in game design. However, there is the difference that, outside games, most design is associated with utilitarian requirements. Even though the aesthetics properties of, for example, a building, are important, there are expectations (and regulations) regarding how it can be used and accessed. Games are far freer from such restrictions.

In the most inclusive interpretation, everyone involved in game development can be considered a designer. Some game scholars from a design tradition also apply this view to games. In some articles *game designer* refers to all professionals involved in development. To complicate things further, some associate design with graphical design. In Japan, a game designer is most often assumed to be a graphical designer or artist. However, in a western context, a game designer is responsible for gameplay (i.e. creating the theme, rules, goals and interaction models that players will experience and interact with). This is

the way the term is used in this book.

The game studies community has shown relatively high interest in game design (compared to other activities involved in game production). In all disciplines, the most referenced game development sources are books on game design. Technically, these do not fall within this book's definition of game development research. However, based on their merits as sources in research that does fall within said definition, they are included here. An overview of these books is presented below along with a short synopsis of studies of game design patterns. Real game development research is then presented in an overview section (as throughout this book).

3.2.1 Game design books

To a large extent, academic publishing related to game design has been books authored by experienced practitioners. The first such book was *The art of computer game design* by Crawford (1984). One of the most cited books is *Rules of play* (Salen and Zimmerman, 2004). Other frequently cited books include *The game design workshop* (Fullerton, 2014), *A theory of fun for game design* (Koster, 2013), *The art of game design: A book of lenses* (Schell, 2008) and *Fundamentals of game design* (Adams, 2014). Another, less cited, but not less important, book is *Characteristics of games* (Elias, Garfield and Gutschera, 2012).

Common to all these books is that they focus on game characteristics, game design and the creative processes behind a game concept. They are mainly based on the authors' personal experience as game designers in projects of different sizes. The books thus contain deep insights into the nature of game development and are highly relevant sources of information. However, it should be noted that the material in these books is not the result of research studies and has not been peer reviewed. These books are either *monographs* or *textbooks* and are primarily targeted at readers who want to understand how to design games. This has the effect of presenting game development more as a solitary activity than as a collaborative production process.

3.2 Game design

3.2.2 Game design patterns

Initiated in the game studies community, an approach that has received much attention is presented in *Game design patterns* (Björk, Lundgren and Holopainen, 2003). The inspiration for this originates from architecture and the idea is to identify design patterns that appear in many games. This latter involves creating a shared terminology for use when discussing design elements in games. Another motivator is that identified patterns should be useful as templates for designing new games.

Although a large number of extensions to the game design pattern concept have been reported in the academic community, reports of pattern use in game production are absent. It appears that the main value of game design patterns is as a descriptive tool for discussing games. There is a clear difference between the above-mentioned work behind game design patterns and that behind design books. The latter are based on experience of applied game design, the former on analyses of existing games.

3.2.3 Research overview

As regards game design and ideation focused studies that include empirical data from industrial practice, Annakaisa Kultima is an outstanding scholar. Kultima focuses strongly on design and has discussed its role in the game studies community (Kultima, 2015)¹. She has also been involved in several empirical studies (Kultima, 2010; Kultima and Alha, 2010; Kultima and Karvinen, 2016) that address the game design process and to what extent it involves systematic methods and tools. One study (Kultima, 2010) presents the results of interviews with 23 game designers in Finnish game companies. Kultima shows that ideas for games can be initiated by individual designers, but they are shaped in a process that involves the other developers:

A ‘good’ idea may not be the one that is fully described from the beginning, but is more inspirational and open-ended in terms of

¹ This article gives a good perspective of game design as a part of a greater design tradition.

allowing the whole production team to modify it. (Kultima, 2010, p. 37.)

This observation corresponds well with the philosophy of production studies (discussed in section 3.1). Kultima shows that game ideation is an organic process. However, she also argues that systematic approaches should be introduced and used. While attributing the lack of systematic approaches mainly to participants' lack of relevant education, she also acknowledges the room for new approaches:

Misunderstanding of systematic approaches towards idea generation and inadequate brainstorming skills distract from the potential of group idea sessions. However, the successful approaches developed by the professionals themselves also indicated the great potential for emergent, novel tools and methods that are especially suitable for game production. (Kultima, 2010, p. 38.)

Ulf Hagen (Hagen, 2009; Hagen, 2011) is another scholar who has studied game design in an industrial context. Basing his observations on interviews with several major Swedish game developers, he highlights aspects related to inspiration for game ideas (Hagen, 2009) and how the design vision is communicated in the team (Hagen, 2011). One of his observations is that, in the studied companies, the player experience vision was not guided by GUX studies but by the designers' own experience:

This approach, however, is not guided by studies of player's experience while playing games; instead, it is primarily based on the designer's own experiences, autobiographical design. (Hagen, 2011, p. 273.)

In addition to the studies above, there are a very few studies of game design in the wild. It is noteworthy that there is a strong overrepresentation of game companies from the Nordic region. The study methods used are a mix of interviews and questionnaires.

3.2 Game design

3.2.4 Recommended reading

This is a must-read for anyone interested in game design research:

- Kultima, A. (2010). “The organic nature of game ideation: Game ideas arise from solitude and mature by bouncing”. In: *Futureplay Conference Proceedings*. ACM, pp. 33–39. DOI: 10.1145/1920778.1920784.

For those who wish to continue reading about game development from a design perspective, I recommend the following articles:

- Hagen, U. (2011). “Designing for player experience: How professional game developers communicate design visions”. In: *Journal of Gaming & Virtual Worlds*, 3 (3), pp. 259–275. DOI: 10.1386/jgvw.3.3.259_1.
- Kultima, A. (2015). “Game design research”. In: *MindTrek Conference Proceedings*. ACM, pp. 18–25. DOI: 10.1145/2818187.2818300.
- Hagen, U. (2009). “Where do game design ideas come from? Invention and recycling in games developed in Sweden”. In: *DiGRA Conference Proceedings*. DiGRA.

3.3 Other game studies topics related to development

In addition to studies that have a clear focus on the actual development process or the design process, there is a large number of game studies articles that, while they involve empirical data from game production, focus on some aspect other than development. Although the methods used in game studies are mainly qualitative, there are several quantitative studies. The case studies offer a mix of big AAA companies and smaller developers. However, the community is strongly geared towards independent game development. This is the explicit focus of several studies (e.g. Parker, Whitson and Simon, 2018; Consalvo and Paul, 2018; Guevara-Villalobos, 2011).

There is quite a diversity in the type of problems addressed in the game studies community. This section highlights some themes identified in the material that includes empirical data from game developers.

3.3.1 Gameworkers

Working conditions in game companies are one aspect of game development highlighted in several studies (e.g. Dyer-Witheford and De Peuter, 2006; Deuze, Bowen Martin and Allen, 2007; Wimmer and Sitnikova, 2012; Legault and Ouellet, 2012; Cote and Harris, 2020). Via interviews with nine German professionals in different positions, Wimmer and Sitnikova (2012) analyse the professional identity of game developers (called *gameworkers* in this context). One of this study's conclusions is that teamwork has a central role for all developers:

Teamwork is also the reason why a gameworker should be familiar with every aspect of the game production process as it implies a lot of collaboration between various members of game development team (programmers, designers, artists, testers, etc.). They also must have a clear understanding of their roles and tasks in the team, as well as of the roles and tasks of their colleagues. (Wimmer and Sitnikova, 2012, p. 166.)

Several studies highlight the role of gender in game development (e.g.

3.3 Other game studies topics related to development

Harvey and Shepherd, 2017; Ahmadi et al., 2019; Bailey, Miyata and Yoshida, 2019). Ahmadi et al. (2019) present a workplace field study at a major German developer with 16% female employees. They make the following observations:

Our findings suggest that the women of our study enjoy working in the company and yet they are confronted with subtle notions of masculinity. The latter are not the result of malicious intent but rather of unreflective, established taken-for granted structures, which affect women throughout their chronological progress within the company. (Ahmadi et al., 2019, p. 416.)

There are several similar studies in which game developers are studied or interviewed, but where the focus is on something other than development practice.

3.3.2 Game jams and cocreation

Conducted outside the game development studio, game jams are an activity that receives attention from the game studies community (e.g. De Salas, Lewis and Bindoff, 2016; Kultima and Karvinen, 2016). De Salas, Lewis and Bindoff (2016) highlight game jams as an opportunity for game companies. The authors present results from surveys distributed to participants at two Tasmanian game jams where 20% of the participants were professional developers. This study concludes that game jams can contribute to the building of a game developer community.

Another aspect of game development that partly lies outside the studio is player cocreation of, for example, game mods. This is an important part of the ecosystem of many games and it has been addressed in a number of studies (e.g. Sotamaa, 2007; Banks and Potts, 2010; Prax, 2015; Joseph, 2018). Many game studies researchers approach this with a critical perspective of the way the industry uses free labour to produce business value. Prax (2015) highlights the perspective that cocreation is a central element in some games (e.g. massive multiplayer online role playing games – MMORPGs) where many types of player actions have

an impact on the game experience. Prax argues that the act of playing a game can be seen as an act of cocreation and concludes that:

There is no clear-cut divide between player creators and institutional game designers in terms of how they are influencing play for others. Instead player creators can have a real impact on how the game is designed in a number of ways that warrant stronger claims for recognition and partial authorship of the game they participated in designing. (Prax, 2015, p. 14.)

Based on two and a half years of ethnographic fieldwork at a mid-sized game studio in the USA, Bulut (2015) highlights the role of QA game testers. He problematises how testers' hobbies and passions can be distilled into labour by game companies under unfavourable conditions:

The precarity testers experience converges with degradation of fun. Lack of prospects regarding permanent employment is combined with the instrumental logic toward play, which kills the joy at work and during leisure time. It is not that testers do not like their jobs. Rather, when one's passion becomes their job, the meaning of play is radically transformed. (Bulut, 2015, p. 253.)

3.3.3 History, culture, and regional aspects

One theme in game studies research relates to history and culture. There are several studies (e.g. Jørgensen, Sandqvist and Sotamaa, 2017; Eyles, 2016) of the historical roots of the industry in certain regions. There are also studies (e.g. Pijnaker and Spronk, 2017; Copplestone, 2017) that address how cultural expressions are represented and created in games.

Regional representation in game studies is generally highly skewed towards Europe, northern America and, to some extent, Asia. Representation of southern America, Africa and Oceania is very low. This book identifies only one study (Pijnaker and Spronk, 2017) that, irrespective of discipline, reflects game development practice on the African continent². The study analyses the app *Africa's Legends* developed by a small team of IT entrepreneurs. It concludes:

² There are some additional examples in the serious games area.

3.3 Other game studies topics related to development

The production of the aesthetics of the African superheroes in Africa's Legends was informed by their social position and taste. The Leti Arts team combined elements of African history and folklore with elements from DC and Marvel Comics. They used digital technologies like Adobe Photoshop and Adobe Illustrator to create the quality they needed to express a new Africanness. (Pijnaker and Spronk, 2017, p. 347.)

3.3.4 Recommended reading

Amongst the articles highlighted in this section, this is a must-read:

- Wimmer, J. and T. Sitnikova (2012). "The professional identity of gameworkers revisited. A qualitative inquiry on the case study of German professionals". In: *Eludamos - Journal for Computer Game Culture*, 6 (1), pp. 153–169.

The following articles are also recommended:

- Deuze, M. et al. (2007). "The Professional Identity of Gameworkers". In: *Convergence*, 13 (4), pp. 335–353. DOI: 10.1177/1354856507081947.
- Ahmadi, M. et al. (2019). "Hacking masculine cultures-career ambitions of female young professionals in a video game company". In: *CHI Play Symposium Proceedings*. ACM, pp. 413–426. DOI: 10.1145/3311350.3347186.
- Jørgensen, K. et al. (2017). "From hobbyists to entrepreneurs: On the formation of the Nordic game industry". In: *Convergence*, 23 (5), pp. 457–476. DOI: 10.1177/1354856515617853.
- Bulut, E. (2015). "Playboring in the tester pit: The convergence of precarity and the degradation of fun in video game testing". In: *Television & New Media*, 16 (3), pp. 240–258. DOI: 10.1177/1527476414525241.
- Prax, P. (2015). "Co-Creative game design in MMORPGs". In: *DiGRA Conference Proceedings*. DiGRA.
- Legault, M.-J. and K. Ouellet (2012). "So into it they forget what time it is? Video game designers and unpaid overtime". In: *Managing Dynamic Technology-Oriented Businesses: High-Tech*

Organizations and Workplaces. IGI Global, pp. 82–102. DOI: 10.4018/978-1-4666-1836-7.ch006.

- Copplestone, T. J. (2017). “But that’s not accurate: the differing perceptions of accuracy in cultural-heritage videogames between creators, consumers and critics”. In: *Rethinking History*, 21 (3), pp. 415–438. DOI: 10.1080/13642529.2017.1256615.

3.4 Forums for game studies research

There are a number of main forums that publish game studies research. In terms of number of papers, the *DiGRA conference* is the primary forum for dissemination of results. It is the most cited forum in this book. In addition to *DiGRA*, there are some other conferences that attract game studies publications. The *FDG Conference* mentioned in section 2.5 is, perhaps, the most important. Its audience is similar to that of DiGRA and the two conferences were even co-organised one year.

There are several journals that publish game studies research. The most prominent of these is *Game Studies* (gamestudies.org, 2020). However, it should be noted that none of the articles related to game development highlighted in this book has been published in this journal. The most cited journal is *Games and Culture* (Sage, 2020b), which states that it:

serves as a premiere outlet for ground-breaking work in the field of game studies and its scope includes the socio-cultural, political, and economic dimensions of gaming from a wide variety of perspectives. (Sage, 2020b.)

One explicit goal of this journal is to bridge the gap between game studies scholars in United States and Europe. It lists “issues of game development” as one of its arenas. Another is “issues of gaming culture related to race, class, gender, and sexuality”. Thus, the focus appears to be on critical studies of game development culture.

In addition to *Games and Culture*, there are a few other journals that appear in the game studies material related to game development. *Journal of Gaming & Virtual Worlds* explores:

the cultural effects of gaming and virtual worlds across platforms and genres, as their increasing popularity begins to affect culture as a whole. (Intellect, 2020.)

This journal is not explicitly focused on game studies but can be seen as a broader media study journal.

Eludamos - Journal for Computer Game Culture (PKP, 2020) is a small independent journal that has been published since 2007. Its focus is

similar to that of the Game Studies journal. In this book, only one article that addresses game development is published in the *Eludamos* journal.

In summary, the main forums for game studies research that address game development are the DiGRA and FDG conferences along with the *Games and Culture* journal.



4. Media production

As discussed in the previous chapter, games share many characteristics with other media products. A studio environment is the birthplace of many different such objects:

Studios play an essential role in bringing into being all manner of aesthetic, affective and reflexive objects including, but not limited to, artworks, brands, buildings, crafted artefacts, concepts, designed products and services, live action and animated films, information technologies, music, software and video games.
(Farias and Wilkie, 2016a, p. 1.)

The flow of ideas and stories between formats has become a central part of our media landscape. There are researchers committed to studies of transmedia, cross-media and media convergence. Thus, it is natural that games have been studied in these contexts and that such study has been undertaken by scholars approaching game production from the perspective of neighbouring media (e.g. movies, literature, art, theatre and music).

This book focuses specifically on studies that include empirical data from game production. The present chapter is no exception. However, results from the areas here are rather thin. Very few studies with a media production perspective focus on game production. In those that do, there

is an overlap with the studies presented in the game studies chapter. Perhaps this is not surprising; game studies has media studies as one of its origins (Aarseth, 2001).

4.1 Games and narratives

The relationship between games and narratives has been the target of an intense debate (Koenitz, 2015). Games' interactive nature makes them different from most other story expressions. It can be argued that the traditional relationship between the author, story and narrative is altered by player input (Koenitz, 2015). *Interactive Fiction*, for example, can be described as: "A potential narrative, that is, a system that produces narrative during interaction" (Jackson-Mead and Wheeler, 2011, p. 26.).

The terminology used differs, but multiple scholars have highlighted the distinction between the system of potential narratives and the resulting narrative that evolves for a specific player. Koenitz (2015) suggests the use of the term *protostory* to describe "a space of potential narratives" (Koenitz, 2015, p. 30). The resulting narrative is referred to as a product. Other authors use *discourse* (Cabioch et al., 2019), or simply an *instantiated narrative* (Kybartas and Bidarra, 2016). From simple branching structures to highly dynamic systems where narratives emerge freely within boundaries set by the creator, the dynamics of a story can vary significantly. The former type can be characterised as an *impositional form* and the latter as an *expressive form* (Meadows, 2002).

Interactivity makes game writing different from, for example, movie writing. The role of the game writer also differs from that of the traditional writer in that it involves the use of hardware and software. There has been a lot of focus on using AI and other forms of advanced technology to create expressive forms of interactive narratives (Klimmt et al., 2012; Cabioch et al., 2019). An example of this is provided by the game Façade (Mateas and Stern, 2003). Although it has received a lot of research community attention, it is not clear to what extent the approach it embodies has been adopted by game developers or been successful in attracting player attention.

The research focused on interactive digital narratives has clear connections to games, but there has been very little integration with the game industry and few studies of how to combine a narrative with other elements of game production. Popular narrative-rich game titles have primarily been *analysed* by game scholars and the production processes

behind them have not received much focus. Some scholars openly express that they expect the game industry to “take on” (Koenitz, 2015, p. 29.) challenges identified by research.

4.1.1 Research overview

Considering the huge interest in interactive narratives and the role of narratives in games, there is a shocking lack of studies of how game companies work with narratives. The most focused description in this area is actually found in one of the user experience studies presented in section 2.3. This is a book chapter written by GUX researchers at Microsoft Studios. In one section, they focus on testing game narratives (Pagulayan et al., 2018b). This text also give insights into the development process. The goal of GUX is to validate that designers’ intentions are actually realised. Regarding narratives, the authors state:

Designers want players to fall in love with the world, to love and mourn characters who are lost, to feel a sense of risk and challenge that motivates gameplay, and to come away feeling as though they have accomplished something grand. Unfortunately, game narratives don’t always deliver on these goals for players.
(Pagulayan et al., 2018b, p. 310.)

They observe that many players who could retell narratives from movies and other linear formats failed to retell narratives from games they had played. For the authors, the solution was to:

Stop trying to test the gameplay build and instead to look at the tools the writers were using to ensure that they ended up with a good story. (Pagulayan et al., 2018b, p. 312.)

Their article presents how simple tools and techniques have been developed and used to analyse game narratives and how players perceive the latter:

The feedback we are able to collect from players – by having them read through, explain what’s going on, what doesn’t make sense, and what they think will happen next – identifies issues

4.1 Games and narratives

with genre knowledge interactions, franchise knowledge (or lack of knowledge), character motivations and inconsistencies, not to mention the basics of plot holes, red herrings, and reversals. (Pagulayan et al., 2018b, p. 314.)

They report a process that starts with a focus on what the story should be, but switches to one on how it should be told. They observe that players tend to evaluate narrative on a more dynamic scale than that they use for gameplay:

They are much more likely to max out on Likert scales, making it important to benchmark your measures before defining success. Gameplay is great at the excitement, tension, and reward cycle; but narrative can build love. (Pagulayan et al., 2018b, p. 315.)

The experiences reported by Pagulayan et al. (2018b) reflect my own experience of working with narrative-driven games (Engström, 2019a; Engström, Brusk and Erlandsson, 2018; Engström, Brusk and Östblad, 2015; Wilhelmsson et al., 2017). As they were mainly conducted in a university context, these games faced exclusion from this book. However, they included professional game developers and one game was developed with professional authors in collaboration with a national public service company (for details, see Brusk and Engström, 2020). Two games were released for public download and received positive reviews. Engström (2019a) includes an interview with three authors who participated in the development of a mobile game. One of them had prior experience of game development, but expressed strong reluctance to using Excel to edit dialogue text. Excel is frequently used for this purpose in game production (Despain, 2008), but game writers assert that alternatives are needed (Francis, 2015).

In a study of the adaptation of the *Spider-Man* movie to two games for five different platforms, O'Donnell (2011) touches upon the role of narrative. He describes the struggle for developers to develop the game's story in relation to that of the film. This included differences in duration and the film's lack of content on which player challenges could be based:

Time and again during the production of [Spider-Man 3], it was apparent that making a game based on the Spider-Man character was a very different undertaking than the production of a movie. (O'Donnell, 2011, p. 274.)

The adaptation of existing intellectual property introduced additional complexities because new content had to be negotiated with the franchise owners. O'Donnell (2011) concludes:

This multiplicity of complexity and interactivity thus leads to a much different storytelling platform, that in many cases tears open the thin veil of formulaity surrounding the stories being offered. (O'Donnell, 2011, pp. 277-278.)

Over and above the already mentioned studies, I am aware of only one article highlighting the process of narrative development in a game industry context. Linderoth (2015) presents results from an interview study with 16 developers from a range of different studios. Linderoth argues that games should be seen as a composite form of both gameplay and story. One of his findings is that:

Informants treat storytelling as a natural part of game development; however, storytelling is not seen as being at the core of the product. (Linderoth, 2015, p. 285.)

4.1.2 Recommended reading

This is a must-read for anyone interested in game development and narratives:

- Pagulayan, R. J. et al. (2018b). "Testing narrative in games". In: *The Wiley Handbook of Human Computer Interaction, Volume 1*. Ed. by K. L. Norman and J. Kirakowski. John Wiley & Sons, pp. 310–318. ISBN: 978-1-118-97727-9.

For those who wish to continue reading about game development and narratives, I somewhat self-promotingly recommend these articles:

- Linderoth, J. (2015). "Creating stories for a composite form: Video game design as Frame Orchestration". In: *Journal of Gaming &*

4.1 Games and narratives

Virtual Worlds, 7 (3), pp. 279–298. DOI: 10.1386/jgvw.7.3.279_1.

- Engström, H. (2019a). “‘I have a different kind of brain’ - a script-centric approach to interactive narratives in games”. In: *Digital Creativity*, 30 (1), pp. 1–22. DOI: 10.1080/14626268.2019.1570942.



Figure 4.1: Screen capture of the E.T. game on Atari 2600.

4.2 Various media types and their relation to game development

As will be apparent from the presentation below, there are very few studies of game development that focus on aspects related to film, art, music, etc. For this reason, all such media types are here addressed in four subsections.

4.2.1 Film, television and games

Games are maybe most frequently compared to live-action and animated films. This has often been manifested by adaptations between formats. In the early days of digital games, movies were often used as themes for games. This was an efficient way of attracting interest and creating an imaginary sphere around the graphically primitive representations possible on the hardware of that time. One such game, *E.T.*, for Atari 2600 (figure 4.1), is said to have caused the big game industry crash in the early '80s (Guins, 2009).

In recent years, game franchises have started to be adapted to movies. This includes not only cinematic action games such as *Tomb Raider*, *Assassin's Creed* and *Prince of Persia* but also movies featuring older 2D-characters such as *Pac Man*, *Sonic the Hedgehog* and *Pikachu*.

Despite the close connections between film and game production, there are very few studies that approach game development from a film

4.2 Various media types and their relation to game development

production perspective. There are several studies that discuss the development of the game industry in different regions and relate it to the film industry (e.g. Chung and Fung, 2013; Izushi and Aoyama, 2006). Hollywood did, for example, play an important role in the development of the North American AAA game industry. Trip Hawkins, founder of Electronic Arts, claims (Ramsay, 2012b) that, taking inspiration from Hollywood media production, he was the one to introduce the terms *director* and *producer* in a software development context. The role of the manga and anime traditions in the development of the Japanese game industry is highlighted by Izushi and Aoyama (2006).

O'Donnell (2011) is unique in his close analysis of game production and how it relates to movie production. He highlights the large differences between the formats and how this affects their development:

Games are quite different from film, music, television, or the myriad other media industries interested in ‘flowing’ content to videogame players. What gamers and game developers have long been aware of, and many executives and decision makers in other creative industries have not yet come to understand, is that games are complex information systems. (O'Donnell, 2011, p. 280.)

This is somewhat contradicted by a study (Nelson and Palumbo, 2014) in which a company introduces a Hollywood film studio model that is claimed to be successful. However, the studied company was not a regular game company but an “interactive new media design firm”. This makes these results more applicable to serious game development (chapter 6).

Television production is closely related to the film industry. In this format, the introduction of audience interactivity is not rare. *Black Mirror Bandersnatch* is a recent example of an interactive television movie. This Netflix film is set in an '80s game developer context, the viewer having to make choices related to the development of a game. McSweeney and Joy (2019) present an analysis of *Bandersnatch* where they relate the film to prior interactive films and to more recent narrative-driven games. They cite interviews with the creators who appear to be ambivalent about

whether or not they created a game. Interestingly, script development used Twine, a tool that has received much attention in an alternative, independent game community (Harvey, 2014). Apart from Twine and the use of game development in the storyline, there is no indication that there was collaboration with game developers in producing the movie.

4.2.2 Theatre and games

Interactive and immersive theatre, as well as live action role playing (LARP), are areas that have strong similarities with games and have influenced game scholars (e.g. Shyba, 2007; Stenros and Montola, 2011). Game design scholars have also influenced the creation of immersive theatre (Harper, 2019). The *Punchdrunk* theatre company has produced several immersive plays, one of the most successful being *Sleep no More*. This has run in New York for many years and encourages audience members to move more or less freely around in a large environment where actors play scenes loosely based on *Macbeth*. There is no dialogue in this play. The drama is created using physical acting and dance. For the audience, the experience is very much like playing a game¹. *Sleep no More* was listed as *Game of the Year* 2011 by one publication (see Harper, 2019, p. 360). This shows that there is potential in approaching games from a theatre perspective. However, to the best of my knowledge, there is no reported study of game development with a focus on theatre aspects.

Role playing games (LARPs or table-top) are strongly related to digital games. They have been the subject of many game study articles (e.g. Tychsen et al., 2006; Drachen et al., 2009). Tychsen et al. (2006) argue that there is potential to use LARPs as foundations when developing MMORPGs:

LARPs are closely related to MMORPGs and provide both a source of ideas to be applied to MMORPGs and an arena to try

¹ I did attend this in 2014 and was blown away by the interactive experience.

4.2 Various media types and their relation to game development

ideas in large participant interactive narratives without the need for extensive software implementation. (Tychsen et al., 2006, p. 271.)

However, I am aware of no study showing that digital game developers have used the suggested approach.

Actors are commonly involved in game productions. Voice-acting is an important part of many games and, in most cases, the interactivity of games makes the dialogue very different from the linear scripts used in theatre and film. This requires actors to understand non-linear script and to act accordingly. Despite the frequent use of actors in game production, I have not found a single study that addresses how actors approach this task or how game companies direct actors in interactive contexts.

In game development projects I have participated in, own tools and procedures had to be designed when working with writers and voice actors (see Engström, 2019a; Engström and Östblad, 2018). However, the process actors used to work with the script and to decide how to act with respect to the context of a scene was not studied.

4.2.3 Art and games

When talking about game and art, there are two fundamentally different aspects that need to be distinguished. The first relates to discussion of whether a game can be regarded as a piece of art. See, for example, Myers (2019). The second relates to the visual dimension of games and how to produce it. All sections of this chapter impinge on the former. This is because artists can use all modalities of a game to express themselves. Two interesting studies of games as art are well worth mentioning. The first of these is Sapsed and Tschang (2014). Focusing on the role of technology, this compares the histories of creative processes behind games and creative processes in the Renaissance. The authors highlight that the introduction of new materials and affordable sketching tools in the Renaissance led to new possibilities for the artistic process (e.g. working iteratively and experimenting). They argue that digital tools have had a similar effect on work processes. They conclude that the two

studied creative epochs:

... were in many ways only separated by the types of technologies, and to some extent, by the manner of technological mediation, but not by the types and needs of human creativity. (Sapsed and Tschang, 2014, p. 140.)

The second study (Devine, 2017) presents a method for art criticism and uses the work of Jason Rohrer as a case study. This study provides a good introduction to how games can be understood as art. In the selection of an artist to study, Devine excluded potential candidates if they lacked acknowledgement from the game world. Devine uses “noticed by the game world” as a selection criterion, but does not specify exactly what this requirement includes. The reasons for selecting Rohrer provide an interesting insight into the art world perspective. Setting out two points stating that Rohrer has “self-identified as an artist” and has “written and verbal artifacts” that can be used to “examine” or “compare” Rohrer’s position, Devine continues:

Third, he is not trained as artist per se but instead has an educational and professional background rooted in computer science and game design. This third point is important because his work has never undergone the rigor of art critique such as is found in art schools. This inexperience, invariably, has created gaps in his work. These gaps allow for discussions that, in turn, add to the dialogue as to how to approach games as art. Fourth, his work has crossed the boundaries of the game and art worlds and has written artifacts to examine on that point. (Devine, 2017, p. 679.)

When it comes to the second aspect of game and art, the production of game visuals, there are very few studies. O’Donnell (2011) is again one of very few to discuss the processes and tools behind game creation. Another example is Canheti, Andalo and Vieira (2018) who, at a Brazilian game studio, followed the process behind the creation of a game character.

In addition to these studies, art is only briefly mentioned in a few other articles (e.g. Stacey, Brown and Nandhakumar, 2007; Hodgson and

4.2 Various media types and their relation to game development

Briand, 2013; Hicks et al., 2018). Lê, Massé and Paris (2013) highlight that art management scholars mainly consider the role of technology at a macro level and rarely focus on the creative process at a micro level: “Technology is rarely perceived as having an impact on the art product itself” (Lê, Massé and Paris, 2013, p. 46).

4.2.4 Music, audio and games

There are surprisingly few works on game audio from a development perspective. Respected scholar Sander Huiberts has published several studies on game audio in both an academic context (e.g. Huiberts, 2010; Huiberts, 2011) and an industry context (e.g. Tol and Huiberts, 2008). However, these latter do not include empirical data. The Audio Engineering Society (AES) has hosted conferences targeting audio for games. This society largely focuses on technology aspects, but the aesthetic dimension is not ignored. In 2020, the University of California Press launched the quarterly *Journal of Sound and Music in Games* (UC Press, 2020). This appears to target exactly what has been missing in this field. As early as issue two, its Industry perspective section featured a study by Krishnaswami (2020). This uses an autoethnographic method to analyse his work as the lead composer for two games, *Dishonored 2* and *Wolfenstein: The New Order*.

The existing academic studies of game audio appear to focus on analyses of existing games, technology and various theoretical aspects, but not on how audio professionals in the industry work collaboratively with other game development professionals. One reason for this may be that many companies use external contractors and do not include music and audio professionals in their core team. This “detachment” is illustrated clearly in the work of Krishnaswami (2020):

I have never experienced my own songs in-world as a player. I experience them, instead, through the eyes and ears of YouTube uploaders and through the words of YouTube commenters and Twitter users. (Krishnaswami, 2020, p. 81.)

It is also illustrated in an article by Mitchell (2014) who interviews: two game composers on their work with horror titles; and, two audio directors on their work with audio and music in games. The interviews give a picture that composing is largely a solitary task. For example:

Most game composers like me, it's just me - I am the team. I may hire a copyist if I have a recording session, but I'm pretty much doing everything else by myself. (Mitchell, 2014, p. 17.)

This interview study has a clear focus on AAA game productions and the discussions with the composers are, to a large extent, focused on comparisons with feature film scores and classical composers. They discuss the choice between classical concert music, aleatory music², texture and the role of silence. In general, the composers are positive towards game composing and comment on the high degree of freedom.

The interviews touch on the role of interactivity and how music can be used to highlight actions in games. Disabling the music is one particular user action that concerns composers:

You don't want to be told how to feel by the music and remember [that] in games, almost always, the player has the option of turning off the music, so you don't want that - that's a bad outcome. (Mitchell, 2014, p. 15.)

When asked what they would like to improve in the way they worked with game music, one of the composers responded:

I could be more involved in integrating music, [or] at least make suggestions on how music can be used. To some extent, if you're hired to write sixty or even one hundred minutes of music in a game that lasts sixteen or twenty hours, they are going to reuse your music. (Mitchell, 2014, p. 16.)

Interestingly, this composer did not think any tools were missing. On the contrary, he stated:

² Music composed using random elements and/or elements that are triggered by the performer.

4.2 Various media types and their relation to game development

But as far as any specific technical tools [go] - we certainly have a lot of them now. If anything I'd like to slow down this technical barrage. If anything say stop, we're done, no more! (Mitchell, 2014, p. 16.)

The composers even expressed the fear that, in the future, they may be replaced by automated systems. For example:

You don't have to know how music techniques are generated, how avant-garde or aleatoric techniques work, you just need to buy a sample library and mix it together. So if anything I worry about music becoming indistinguishable from sound effects and losing something in the process. (Mitchell, 2014, p. 14.)

The audio directors interviewed in Mitchell (2014) were mainly asked about their processes for using temporary tracks in the prototyping phases before a composer delivers the original music. They said that selecting music helped the team to set the mood of different sections of the game. One director explained how he used collections of audio cues to communicate the musical vision of a game to a composer:

Each level had a collection of 'Ambiance' cues for establishing the mood, 'Reveal' cues for story moments and 'Fight' cues that would be used for combat situations. The direction for each cue came from the overall direction of the game level (at that time). (Mitchell, 2014, p. 24.)

The studies presented here are the only ones I found that examine how composers and audio specialists work professionally. However, Mitchell (2014) is a good example of the potential of such studies. It is clear that game development differs from the standard work of these professionals and poses different challenges.

An interesting example of the similarities between game development and music production is presented by Baba and Tschang (2001). This study is presented in a management context and highlights the use of prototyping in a creative process. They claim that the highly innovative

Sgt. Pepper's Lonely Hearts Club Band album was the result of a prototyping process where composing and recording were no longer approached as sequentially separated processes. They also highlight the importance of the tight collaboration between people with different competencies. This included composers and performers (e.g. Lennon and McCartney), studio engineers (e.g. Geoff Emerick) and a producer (George Martin). Besides a remarkable album, this new way of working also resulted in a new way of creating music:

The emergence of the 'Sgt. Pepper's' model was regarded as phenomenal as it introduced prototyping in record production, and contributed to a new record category of the concept album. The nature of production process helped the 'Sgt. Pepper's Lonely Hearts Club Band' album achieve a very high artistic standard with remarkable product integrity. (Baba and Tschang, 2001, p. 496.)

The tight collaboration in *Sgt. Pepper's* ... cannot be observed in the process described by Mitchell (2014). There, composers said that they felt they worked on their own, with limited control of how the music was used. However, they did express hopes for improvements and believed that music in games could develop its own unique identity:

The Bach of game music may yet write intricate music that perfectly weaves together. I see the opportunity for good game music to evolve and do something unique that a score for a film cannot do. (Mitchell, 2014, p. 19.)

4.2.5 Summary

It is clear that there is very little research that addresses game development from a media production perspective, irrespective of whether it is from a narrative, film, art or music angle. However, it should be noted that each of these fields has some examples of such research. This gives some hope that things may evolve in the future. It is possible that this community has a very high inertia and, consequently, orientation towards the relatively new field of games is slow.

4.2.6 Recommended reading

This is a must-read for anyone interested in games and media production:

- O'Donnell, C. (2011). "Games are not convergence: The lost promise of digital production and convergence". In: *Convergence*, 17 (3), pp. 271–286. DOI: 10.1177/1354856511405766.

For those who wish to continue reading about game development from a media production perspective, I recommend the following articles:

- Mitchell, H. R. (2014). "Fear and the musical avant-garde in games: Interviews with Jason Graves, Garry Schyman, Paul Gorman and Michael Kamper". In: *Horror Studies*, 5 (1), pp. 127–144. DOI: 10.1386/host.5.1.127_1.
- Nelson, W. A. and D. B. Palumbo (2014). "When design meets Hollywood: Instructional design in a production studio environment". In: *Design in Educational Technology*. Ed. by B. Hokanson and A. Gibbons. Springer, pp. 75–88. DOI: 10.1007/978-3-319-00927-8_5.
- Devine, T. C. (2017). "Integrating games into the artworld: A methodology and case study exploring the work of Jason Rohrer". In: *Games and Culture*, 12 (7-8), pp. 671–695. DOI: 10.1177/1555412015596105.

4.3 Forums for media production game research

As is apparent from the discussions in this chapter, media production research that highlights games is very sparse. This makes it difficult to identify forums that might publish such research (if it were not as rare). The few examples found and highlighted here may not be representative of the field. There is a clear overlap between the forums for game studies and those for media production. As pointed out in section 3.4, *Journal of Gaming & Virtual Worlds* is also a relevant forum for media production research.

Another journal that is on the border between the fields is *Convergence*. Its main aim is to:

encourage and advance interdisciplinary modes of enquiry into the study of the histories, trajectories, impacts, practices, pleasures and creative potential of contemporary convergent media and allied innovative technologies. (Sage, 2020a.)

The journal does not have an explicit focus on games, but several articles highlighted in this book have been published there.

In addition to these journals, there are some that make single appearances, e.g. *Horror Studies* (Ingenta, 2020) and *Digital Creativity* cited above. The latter could be highly relevant given its stated publication scope of:

articles of interest to those involved in the practical task and theoretical aspects of making or using digital media in creative disciplines. These include but are not limited to visual arts, interaction design, physical computing and making, computational materials, textile and fashion design, filmmaking and animation, game design, music, dance, drama, architecture and urban design.. (Taylor & Francis, 2020a.)

However, very few of the articles that the journal publishes within this scope address applied game development.

As mentioned above, there is a newly started journal that targets audio and music in games. This is the *The Journal of Sound and Music*

4.3 Forums for media production game research

in Games and it has the potential to present research that is relevant to this book's purposes. The journal claims it is:

the only journal exclusively dedicated to this subject and provides a meeting point for professionals and academics from any tradition to advance knowledge of music and sound in this important medium. (UC Press, 2020.)

Conferences appear to be of low importance in the media production field, particularly in comparison to their position in software development. The only conference papers cited in this chapter are published at the DiGRA conference. This does not necessarily imply that the specific communities (e.g. music and sound) do not have relevant, focused forums that address games. In many communities, there are conferences that accept presentations based on short abstracts. Other communities (e.g. interactive digital narratives) have conferences that publish proceedings with full papers, but lack a focus on game development in the wild.



5. Management and business

Identifying rational ways to operate businesses is one focus of classical management research. It involves identifying how resources (human resources included therein) should be utilised. Although the roots of management run deep into the history of civilisation, the industrial revolution can be seen as the starting point of the field (Pindur, Rogers and Kim, 1995). Today, management is a wide field that has some clear overlaps with research in software engineering (section 2.1) and information systems (section 2.2). Management research (just like research in the two previously mentioned fields) employs several different research paradigms. Management research can also employ behavioural or quantitative approaches (e.g. using game theory¹) or, for example, be more in the nature of anthropological studies of workplace cultures.

This chapter focuses on studies addressing game development management from a perspective that is wider than software development. In the totality of research addressing game development, a substantial subset comes from the disciplines presented in this chapter. It includes

¹ Game theory is a mathematical model that can be used to analyse decision making. It is applicable in game design but it is mainly used in economics.

traditional team management aspects that are highly relevant in the daily operations of development teams. Aspects related to finance, analytics and publishing can be considered as outside core development tasks. Nonetheless, they are crucial in creating a sustainable game business and thus strongly influence core development.

As discussed in section 2.3, analytics can be used to support both design and business intelligence. This chapter focuses on analytics applications to support business elements. However, because design and business affect each other, it is not possible to completely separate them.

5.1 Creativity management

Creativity is a topic that has been studied from many perspectives ranging from psychology to business.

Advertising was one of the first business areas where creativity was highlighted (Bevolo, 2010)². Employee creativity is an important resource in many modern businesses. Accordingly, management scholars have started to study how this resource should be managed:

Creativity management is a system of principles, methods, techniques, practices, and instruments for managing employee creativity in order to get the maximum effect for the organization according to its goals, objectives, employee contingent, and available resources. (Dubina, 2013.)

As game companies have an apparent need for creative individuals, the latter have attracted attention from management scholars.

This section focuses on research that has studied game development management. The majority of such studies has some focus on the creative aspects of game development and how managers should make space for it.

5.1.1 Research overview

There are several studies that focus on game project management (e.g. Walfisz, Zackariasson and Wilson, 2006; Cohendet and Simon, 2007; Cullmann, 2013; Hodgson and Briand, 2013). Some of the first and most ambitious studies of game management were presented by Ted Tschang and his colleagues (Baba and Tschang, 2001; Tschang, 2005; Tschang and Szczypula, 2006; Tschang, 2007; Tschang, 2009). The foregoing research mainly focuses on aspects one step above project management. In an early study, Baba and Tschang (2001) analyse Japanese console game (referred to as *TV game software*) development and identify how it differs from traditional software development:

² One text promoted by Bevolo (2010) is “A Technique for Producing Ideas” by Webb Young (1965). In my opinion, this very short book captures the nature of creative processes extremely well.

Software has traditionally been seen as an efficiency-driven process. But in innovative software, there are other important issues, such as the need to allow for radical redesign in development cycles, and the need to resolve tensions between creative and controlling processes. (Baba and Tschang, 2001, p. 487.)

A subsequent study (Tschang, 2005) highlights the unique characteristics of game development in comparison to the characteristics of other entertainment products. Amusement park rides are an example. These should give users a few minutes of (non-interactive) amusement and, to a large extent, their characteristics can be based on existing attractions. Thus, they can use *normal development processes*:

On the other hand, the designing of a videogame that a consumer has to enjoy and desire to persist playing on a dynamic (i.e., constantly changing) basis over many hours of game play can be said to be an extreme requirement. (Tschang, 2005, p. 113.)

Said study analyses postmortems to identify game development characteristics. Tschang's most cited work (Tschang, 2007)³ studies North American game development using a combination of ethnographic methods, interviews and post-mortems. It focuses on creativity management in game development and how to balance rational forces and the need for games to provide creative elements. Tschang defines rationalisation as: "The predominant focus on business interests or productivity-oriented production processes, usually at the expense of creativity" (Tschang, 2007, p. 989).

In combination with specific characteristics of entertainment products⁴, rationalisation can easily lead to incremental innovation. This means that such products see only minor changes to their components. The study gives a good characterisation of the AAA industry and the

³ This is one of the most cited (irrespective of discipline) works on applied game development.

⁴ Entertainment products are characterised by: being hit-oriented; having short product lifecycles; and, the unpredictability of their acceptance by customers.

5.1 Creativity management

relationships between studios, publishers and audiences. Tschang (2007) shows how creativity can be supported in a game studio despite the *rationalising forces* exerted by publishers and commercial interests.

Two other early articles (Walfisz, Zackariasson and Wilson, 2006; Zackariasson, Walfisz and Wilson, 2006) are based on an ethnographic study at a major Swedish game studio. The first article (Walfisz, Zackariasson and Wilson, 2006) presents the project structure used at the studio. It gives a rich description of the management philosophy used there. The article's first author is the company's CEO (which may have impacted on the critical analysis). Jointly, the authors highlight the balance between structure and creative freedom:

Impose a loose—tight discipline throughout the project. At the heart of the process was the 10 day cycle, a tight constraint. At the same time, the creative excursions of individuals were encouraged.
(Walfisz, Zackariasson and Wilson, 2006, p. 498.)

The second article (Zackariasson, Walfisz and Wilson, 2006) analyses the creative process in game development and the role of management in this process. It concludes that the studied game company shows many similarities with companies in other businesses and that many observations made in the case company could be associated with classical management concepts.

It should be noted that, since the above studies were presented, the nature of the game industry has changed substantially. In the past fifteen years, the industry has seen the indie revolution, the growth of mobile games and the opportunity to self-publish games. This is reflected in a recent study by Granados (2018), who interviewed 38 developers at high profile European mobile game developers. This study's results echo those presented by Tschang, but one important difference is highlighted, i.e. the free-to-play business model has turned development into an ongoing process, even after game launch. Granados (2018) identifies this as a *servitisation* of the game business. The data collected from gameplay serves an important role in the refined development of the game. This brings a strong rationalisation force into game development.

Focused on creative business realities, another recent study (Wikhamn et al., 2016) interviews 36 Swedish game developers. They identify three ambidextrous capabilities that companies need to handle. These relate to: creative work vs. efficiency; inward vs outward ideation influences; and, the diversity in the team vs. the shared love of games.

A common theme in the research on game development management is the constant balancing between contradicting goals and complex structures. In Simon (2006), four case studies (game industry, multimedia, advertising and circus) are used to analyse project management. Simon suggests that, here, a project manager needs to take on the roles of a *sense-maker*, a *web-weaver*, a *game-master* and a *flow-balancer*. The role of successful project manager embodies a complex mix of skills directed towards bringing different people together to produce a creative result. A need for the project manager to connect the different cultures of different disciplines (*web-weaver*) is highlighted:

The [project manager] has to learn the culture, ethos and even jargon of each profession involved in the project. This let us think that curiosity and a strong interest for discovery lies at the heart of the [project manager] job, in parallel with strong skills in listening and learning. (Simon, 2006, p. 121.)

In this connection, sociology researchers Vaan, Stark and Vedres (2015) studied how, as a function of cognitive distance between groups, creative success depends on the structural composition of the creative team. Their assumption is that:

where the groups comprising a team are cognitively (stylistically) distant, members might confront a babel of dissonant languages, where even the same term might not have the same meaning. Cognitive diversity has potential to shake up existing codes and categories, leading to the development of innovative products. (Vaan, Stark and Vedres, 2015, p. 1150.)

They use an extensive set of data, primarily derived from *Moby Games* (Blue Flame Labs, 2020). This set includes 8,987 games

5.1 Creativity management

published between 1979 and 2009 created by 139,727 developers. The results indicate that the combination of cognitive distance and overlapping groupings promotes innovation.

A different study, (Cohendet and Simon, 2007), examines a large Canadian game company and the role of the communities of specialists therein:

As a result, most of the communities of specialists at [the game company] have a dual dimension in the way they process knowledge, aiming both at exploration and exploitation. As the balance varies from one community to the other, the community of game designers probably has the most weight on exploration. However, the coexistence of many diverse communities having both dimensions is one of the distinctive characteristics of cultural industries and explains why these types of organizations finally succeed in matching creativity and efficiency. (Cohendet and Simon, 2007, p. 591.)

The authors discuss the role of these communities in relation to the formal structures of the company and conclude that they all serve an important role and that the system is complex:

There is no fixed recipe, no standard platform or permanent procedure. There is a large diversity of platforms and bundles of strong and weak ties that connect communities together, link projects to communities and also bind the diverse sources of creativity to the global culture of the company. (Cohendet and Simon, 2007, p. 602.)

Cohendet and Simon have been studying game development management for more than a decade and have published several studies of a major AAA studio in Montreal (e.g. Cohendet and Simon, 2016; Cohendet, Llerena and Simon, 2014). One article (Cohendet and Simon, 2016) gives a very interesting insight into the inner operation of the largest game studio in the world. The stage-gate process, traditionally used in game production, resulted in a lot of frustration when the creative team and the team of editors did not manage to make progress in the ideation stage of a new game:

Given the infrequent contact between the creative team and editorial, these evaluation meetings often turn into a “dragon’s den” where the producer has to explain, justify, and fight for his and the team’s ideas. (Cohendet and Simon, 2016, p. 621.)

When the producer finally mooted leaving the job, the company did not want to lose one of its big talents and gave him free rein to organise the work. This gave rise to the *always playable* project that is analysed in the article. The producer introduced two development principles: “fail fast” and “follow the fun”. Team focus was on creating playable prototypes that they playtested via weekly tournaments. This attracted interest from large parts of the organisation, eventually also including the studio’s president:

The good thing with the playable prototype is that it gives us a real sense of direction. It’s easier for the team to feel what works and what doesn’t. (Cohendet and Simon, 2016, p. 622.)

Thus, the *always playable* project was successful in redesigning the core process used in the development of a potential blockbuster game.

In a related study, Hodgson and Briand (2013) examine the use of an agile development method, Scrum, at another Canadian studio. This method is a permanent procedure that has become established in a software development context. Hodgson and Briand (2013) found that this approach was not successfully implemented throughout the team. While programmers embraced the methodology, artists found it to be too rigid to support their process. To handle this, project management had to circumvent Scrum and implement other procedures to support the artists. The authors conclude:

Given the current vogue for the adoption of Agile and similar methodologies, there is a pressing need for more extensive, cross-sectoral and critical research into its implementation and the consequences for control. (Hodgson and Briand, 2013, p. 322.)

The studies presented above illustrate that even established AAA companies struggle with game development processes. Both the creative

5.1 Creativity management

nature of the product and the diversity of the team generate challenges. This management problem has not been solved.

In the development structure, with all its complexities, technology is an important component that concerns not only people with a technological background. Lê, Massé and Paris (2013) present an interesting study of how technological change affects the creative process. The study is of a major French game company and analyses how technology interacts with the creative process.

Our findings also serve to reaffirm, with respect to the literature on technology, that the artistic process is specific. Compared to traditional industries, where the objectives are set and predefined by rational targets or other activities such as fundamental scientific research, the cultural and creative industries present a more open-ended setting. Indeed, artistic products do not fit the traditional product-development model. (Lê, Massé and Paris, 2013, p. 57.)

Several studies in the management field (e.g. Lysova and Khapova, 2019; Musial, Kauppinen and Puhakka, 2016) highlight how important game developers' personal motivation is for the result. Lysova and Khapova (2019) present an interview study of 24 Dutch game company founders and conclude that a common theme for these individuals is that they have a *creative calling* to perform creative work and develop games. Said individuals started their companies as a way of following this calling. The authors observe an *emerging entrepreneurship*:

The majority of the interviewed founders did not start their company because they wanted to be an entrepreneur but rather because it was the only way for them to do what they love. (Lysova and Khapova, 2019, p. 38.)

The article shows that the founders experienced challenges in combining their calling with their work identity. This suggests that:

Career counselors and career development professionals could help these individuals to craft their idealized work identity into the

one that better fits reality and to be more adaptable in the way they enact their calling. (Lysova and Khapova, 2019, p. 42.)

Highlighting the same conflict between artistic creativity and business practicalities, a study by Musial, Kauppinen and Puhakka (2016) draws a different conclusion:

Creative work is a distinct way of living. Therefore, it is not an industrially manageable process but, rather, a culturally embedded phenomenon. (Musial, Kauppinen and Puhakka, 2016, p. 1277.)

One striking observation regarding the literature on creativity management is that it contains many studies that have rich empirical data from major developers in the AAA sector. North American and north European studies strongly dominate creativity management research. Canadian and Swedish studios are also notably well represented. The majority of all these studies uses qualitative methods (interviews being dominant).

5.1.2 Recommended reading

This is a must-read for anyone interested in management research addressing game development:

- Tschang, T. (2007). “Balancing the tensions between rationalization and creativity in the video games industry”. In: *Organization Science*, 18 (6), pp. 989–1005. DOI: 10.1287/orsc.1070.0299.

For those who wish to continue reading about management research, I recommend the following articles:

- Cohendet, P. and L. Simon (2016). “Always playable: Recombining routines for creative efficiency at Ubisoft Montreal’s video game studio”. In: *Organization Science*, 27 (3), pp. 614–632. DOI: 10.1287/orsc.2016.1062.
- Lê, P. L. et al. (2013). “Technological change at the heart of the creative process: Insights from the videogame industry”. In:

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- International Journal of Arts Management*, 15 (2), pp. 45–59. URL: <https://www.jstor.com/stable/24587112>.
- Hodgson, D. and L. Briand (2013). “Controlling the uncontrollable: ‘Agile’ teams and illusions of autonomy in creative work”. In: *Work, Employment and Society*, 27 (2), pp. 308–325. DOI: 10.1177/0950017012460315.
 - Cohendet, P. and L. Simon (2007). “Playing across the playground: Paradoxes of knowledge creation in the videogame firm”. In: *Journal of Organizational Behavior*, 28 (5), pp. 587–605. DOI: 10.1002/job.460.
 - Simon, L. (2006). “Managing creative projects: An empirical synthesis of activities”. In: *International Journal of Project Management*, 24 (2), pp. 116–126. DOI: 10.1016/j.ijproman.2005.09.002.
 - Walfisz, M. et al. (2006). “Real-time strategy: Evolutionary game development”. In: *Business Horizons*, 49 (6), pp. 487–498. DOI: 10.1016/j.bushor.2006.04.001.
 - Tschang, F. T. and J. Szczypula (2006). “Idea creation, constructivism and evolution as key characteristics in the videogame artifact design process”. In: *European Management Journal*, 24 (4), pp. 270–287. DOI: 10.1016/j.emj.2006.05.003.
 - Tschang, T. (2005). “Videogames as interactive experiential products and their manner of development”. In: *International Journal of Innovation Management*, 9 (1), pp. 103–131. DOI: 10.1142/S1363919605001198.

5.2 Business

Business is an applied part of the vast field of economics (which ranges all the way from micro to macro). The focus in this book is limited to studies that have empirical data from game development and address aspects affecting such operations. This excludes not only all macroeconomic aspects, but also many of the microeconomic studies that focus on the digital games market without considering actual development. The focus here is mainly on business studies. Business involves aspects related to marketing, finance, information intelligence and entrepreneurship. As for any company, business aspects tightly control the operation and survival of a game studio. With the new value chain and its possibility of self-publishing, developers also have to manage publishing aspects.

The community of academics studying business has shown major interest in the game industry. As game revenues are substantial, this is not surprising. However, research focusing on development aspects is quite limited. Most business studies focus on higher level industrial aspects and are thus not included in this book. One such area that has received a lot of attention is the concept of creative cities and the mechanisms behind successful clusters of companies. Although studies at a higher level (e.g. Corts and Lederman, 2009; Marchand and Hennig-Thurau, 2013; Ernkvist and Ström, 2018) may help developers in their decision making, they do not really link to the development process and are thus excluded from this book. The enforcement of this imperfect boundary resembles the article exclusions in previous chapters. However, this book aims only to give a very broad overview. Anyone interested in a specific area will have to go beyond the material highlighted here. The recommended reading in section 5.4 is a good starting point.

5.2.1 Research overview

Excluding all high-level studies of creative cities still leaves a number of studies (e.g. Pottie-Sherman and Lynch, 2019; Chaminade, Martin and McKeever, 2020; Lehtonen, Ainamo and Harviainen, 2019) with a regional focus on the game development business. These studies have

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a studio-close perspective and include empirical data from individual developers. One such study is Chaminade, Martin and McKeever (2020). This analyses the role of local and global networks for developers in southern Sweden. The authors conclude:

The findings provide a more nuanced view on the complementarities between regional and global innovation networks. Indeed, firms draw upon various regional and global networks in order to develop more efficient, cost effective, and innovative products and services. Conversely, localized interactions and knowledge exchange can also act as a catalyst and enabler for [global innovation network] engagement. (Chaminade, Martin and McKeever, 2020, p. 12.)

In other words, the study questions the one-sided focus on the local network in creative industries. This conclusion is supported in studies of other game clusters in Canada, Finland and Japan. In one interesting study Lehtonen, Ainamo and Harviainen (2019), industry professionals were asked to each draw a picture of their local game ecosystem. These drawings showed a great variation in style. They also revealed that developers have a perception of closeness that does not necessarily relate to geography:

Although the respondents were asked to focus on their physical location, several drawings transcended their setting spatially, thus highlighting the importance of global networks at a local level. (Lehtonen, Ainamo and Harviainen, 2019, p. 12.)

There are several business research studies that focus on crowdfunding (e.g. Cha, 2017; Steigenberger, 2017). Steigenberger (2017) surveys supporters of reward-based crowdfunding to discover their motives for supporting specific projects. The results show that most supporters are driven by a desire to acquire the product. These investors focus on supporting specific persons or firms to develop the product they envision. These results have implications for how developers should approach crowdfunding campaigns:

The insights obtained in this study imply that the entrepreneurs will need to focus on a market niche and also address the altruistic and information motives to some degree in order to be successful, where finding the appropriate market niche is of much higher importance. In addition, the entrepreneurs might benefit from sending signals of professionalism. (Steigenberger, 2017, p. 350.)

Styhre and Remneland-Wikhamn (2019) is a study focusing on independent game developers and their attitudes towards money. It is based on interviews. These were mainly with developers, but people in peripheral roles (educators, journalists, incubator managers, etc.) were also included. The study shows that indie developers have a complex relationship with money and business logic. In general, they are sceptical of game development's commercial side:

In many cases, the business side of video game development was treated as a necessary evil that needs to be contained within broader professional commitments to video game development. (Styhre and Remneland-Wikhamn, 2019, p. 12.)

This attitude differs from that of other entrepreneurs in the IT sector. Despite this attitude, there is still an acceptance that, provided they do not focus on monetary aspects during development, successful independent games generate large profits for their developers. There is a *gaming ethos* that regulates how, for example, in-game purchases can affect progress in the game. The different relationship to money is also noticeable in salary levels compared to those of other businesses. Styhre and Remneland-Wikhamn (2019) conclude:

Both management studies and entrepreneurship research scholarship should therefore pay closer attention to how professional and social norms and values shape business practices and industries more widely. (Styhre and Remneland-Wikhamn, 2019, p. 20.)

One interesting study (Dezso, Grohsjean and Kretschmer, 2010) uses the credit listing of *MobyGames* (Blue Flame Labs, 2020) in combination

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with US revenue data to analyse how commercial success is determined by team members' experience (managerial experience included therein). This approach differs drastically from management studies in that it uses a quantitative instrument and is only concerned with commercial success. One of this study's findings is that the task experience (e.g. 3D modelling) of people in leading roles is not an indicator of likely success. However, their managerial experience is. The study also looks at the impact of team familiarity (team members having worked together in previous projects) and firm familiarity (team members having worked on projects in the same firm). Game companies are given the following recommendations by the authors:

If a firm has effective coordination routines, teams can be put together based on criteria other than team familiarity, as shared firm experience is sufficient to achieve effective coordination. Absent such established routines, fluid teams might decrease performance, at least in the short term. In the long run, fluid teams may increase teaming experience and thus compensate for short-term performance deficits. (Dezso, Grohsjean and Kretschmer, 2010, p. 5.)

The research in the business area includes both qualitative and quantitative studies (the latter slightly dominating). Sweden and North America are strongly represented in this research. The studies mainly involve smaller, independent developers but, AAA game companies are also present.

5.2.2 Recommended reading

This is a must-read for anyone interested in business research that addresses game development:

- Styhre, A. and B. Remneland-Wikhamn (2019). "The ambiguities of money-making: Indie video game developers and the norm of creative integrity". In: *Qualitative Research in Organizations and Management*, 15 (3), DOI: 10.1108/QROM-02-2019-1733.

For those who wish to continue reading about business research, I

recommend the following articles:

- Chaminade, C. et al. (2020). “When regional meets global: exploring the nature of global innovation networks in the video game industry in Southern Sweden”. In: *Entrepreneurship & Regional Development*, pp. 1–16. DOI: 10.1080/08985626.2020.1736184.
- Lehtonen, M. J. et al. (2019). “The four faces of creative industries: Visualising the game industry ecosystem in Helsinki and Tokyo”. In: *Industry and Innovation*, pp. 1–26. DOI: 10.1080/13662716.2019.1676704.
- Dezso, C. L. et al. (2010). “The what, the who, and the how: Coordination experience and team performance in the electronic game industry”. In: *Academy of Management Proceedings*, 2010 (1), pp. 1–6. DOI: 10.5465/ambpp.2010.54493896.

5.3 Publishing and analytics

The business models used for games have shifted over the years. They link to game design in several ways. Arcade games were the first commercial games. Here, players paid a small amount to play for a limited amount of time. Thus, it was important for game designers to balance play duration and profitability. Players must not end up feeling robbed but, at the same time, their single payment must not give them hours of play.

For console and PC games, the traditional business model was pay-to-play, i.e. customers payed a fixed one-time amount for the game. Games were sold in relatively standardised price ranges. A baseline price for a AAA game was around EUR 60. With this model, a culture evolved whereby it was important to provide long playtimes.

Online gaming introduced the subscription-based business model (or game-as-a-service). Here, players pay a monthly fee that gives access to game servers and services. An important component of these games is the social dimension of playing.

Finally, social-network and mobile games popularised the free-to-play⁵ business model. Here, revenue can come from micro-transactions such as players paying to buy virtual items. Another possible source of income is the inclusion of advertisements that interrupt gameplay (e.g. see Burns, Roseboom and Ross, 2016).

In the game industry's traditional value chain (figure 5.1), the developer focused on producing a game that was delivered to a publisher who duplicated physical copies for distribution to retailers. Customers bought and played the game on hardware that was not network connected. The amount of time spent on games, the actions player took or other details from game sessions were not available for analysis by developers. This meant that the only hard fact propagated back from players was the number of sold units. Players were simply customers. Publishers were responsible for marketing, sales and negotiations with developers. In

⁵ The terms free-to-play and freemium are typically used interchangeably. See Alha (2019) for a review of free-to-play research.

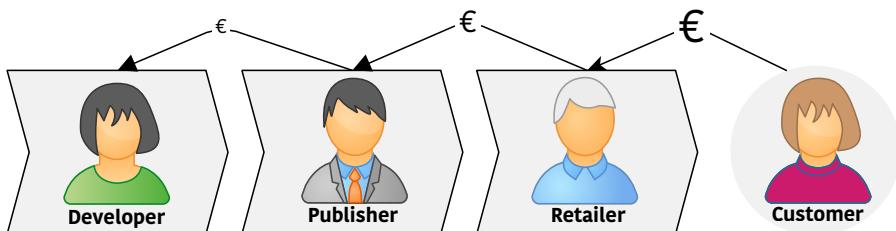


Figure 5.1: The traditional value chain for games where money is the only thing flowing from players to developers.

turn, these latter were mainly concerned with game development.

This value chain has undergone a notable change over the past 25 years. Through game telemetry, the introduction of online gaming has provided new ways of monitoring player activity. It has also provided developers with new distribution models (figure 5.2) that enable self-publishing. Distribution platforms such as Google Play, App Store and Steam charge developers relatively small sums for their service. Consequently, a larger part of the upfront payment reaches the developer⁶.

However, digital distribution platforms provide very limited publishing support. Although, in practice, anybody can publish games on these platforms, very few will be selected for promotion by the platform. This has led to a situation where increasing numbers of developers need to carry out tasks that have traditionally been carried out by publishers. Developers can also trace player activity at a very detailed level. This enables the use of a rich set of analytical tools that aid business and design decisions. According to Drachen, El-Nasr and Canossa (2013), three types of metrics are used in game analytics:

- *User metrics* – these relate to user activity from the perspective that they are either customers or players.

⁶ Note that the models presented here are highly schematic. Important elements such as hardware manufacturers, middleware providers, outsourcing companies, etc. have been omitted.

5.3 Publishing and analytics

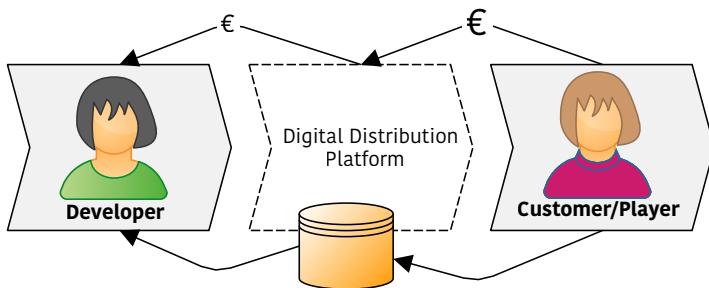


Figure 5.2: The new value chain for games where players provide developers with both data and money. The publisher and retailer have been replaced by a digital distribution platform.

- *Performance metrics* – these relate to the technical performance of games when they are run on different platforms, potentially with networks and servers.
- *Process metrics* – these relate to the performance of the development team.

This section focuses on an intersection of these metrics that illuminate management and business aspects, many of which have traditionally been handled by a publisher.

5.3.1 Research overview

The majority of the research on game analytics focuses on free-to-play games. In this business model, developers depend on active players providing revenue through in-app purchasing or accepting exposure to advertising.

Player retention is the key metric studied in the vast majority of articles. It is the percentage of players returning to a game after the initial session. Many studies (e.g. Weber et al., 2011; Burns, Roseboom and Ross, 2016; Mäntymäki, Hyrynsalmi and Koskenvoima, 2019; Lassila, Moilanen and Järvinen, 2019) highlight the importance of

retention. Lassila, Moilanen and Järvinen (2019) conducted interviews at four Finnish game companies that develop free-to-play games. They interviewed people at different levels, from operational to executive. The results show that most respondents identified retention as the key metric. One business manager stated:

Retention has to be good. And to achieve that good retention, the game itself has to be good for real, ... (Lassila, Moilanen and Järvinen, 2019, p. 2154.)

This quote illustrates the company making a straight connection between retention and game quality. Companies also consider monetisation aspects to be easier to fix once retention is good. Retention is also highlighted as an important factor in pay-to-play games. Weber et al. (2011) present a study focusing on retention in the AAA game *Madden NFL*. The reasons they give for focusing on retention resemble those for free-to-play games, but with a longer timescale:

The intended impact of answering these questions is to improve player retention, which will increase potential for year-to-year purchases and secondary revenue sources, such as in-game purchases. (Weber et al., 2011, p. 1701.)

Many articles analyse retention for specific games (e.g. Demediuk et al., 2018; Debeauvais et al., 2011; Park et al., 2017). Some of these focus on retention in massive multiplayer games. Park et al. (2017) analyse player logs from a long-running Taiwanese MMORPG and use a regression model to identify factors that predict retention. In this analysis, they consider players' "virtual life phases" (which more or less correspond to the level players have reached in the game). The results show that while the social activities of high-level players have a strong predictive strength, achievements do not. However, low level players' achievements have a major impact. The authors give developers the following recommendations:

Game designers may offer fast achievement-oriented scenarios at the beginning, while motivate players to form strong social

5.3 Publishing and analytics

relationships long before they reach any advanced level. (Park et al., 2017, p. 452.)

This study illustrates the dual role of analytics. They support business goals while also addressing game design aspects. Lassila, Moilanen and Järvinen (2019) report that, when weak retention was detected, management trusted developers to improve the game. Analytics were then used by developers to create a more detailed understanding of the game and its weaknesses. The authors summarise this dual role:

These metrics, as inscriptions, concretised the enjoyment from the creativity perspective and money spending from the economic perspective, and thus worked through analytics as a mediating instrument [...] linking the domains of creativity and financial reasoning together. (Lassila, Moilanen and Järvinen, 2019, p. 2155.)

Not surprisingly (considering the nature of the field), there is a strong focus on quantitative methods in the research. However, there are some qualitative studies (e.g. Mäntymäki, Hyrynsalmi and Koskenvoima, 2019; Su, Backlund and Engström, 2020; Lassila, Moilanen and Järvinen, 2019) where developers are interviewed about their opinions of analytics and self-publishing. These studies give insights into the motivations for companies to use analytics:

We don't do analytics because they are cheaper, but because they are better. I never trust people who say, 'If you would develop this, I would use it all the time.' Only when I can measure that they really use it, will I believe it. (Mäntymäki, Hyrynsalmi and Koskenvoima, 2019, p. 8.)

They also reveal that small and medium-sized companies have very limited resources for carrying out analytics. They use standard tools and struggle to interpret the results. A CEO at a small Chinese independent studio explains:

We do not have dedicated analysts so we cannot do deep analysis of these data. All we do is simply collect the data using third-party

game analytics tools and compared with the benchmark if we meet the requirement. (Su, Backlund and Engström, 2020, p. 5.)

In a different study, Mäntymäki, Hyrynsalmi and Koskenvoima (2019) draw the following conclusion from their interviews with small and medium-sized companies:

Overall, our study portrays a different picture of game analytics than the prior research that has listed numerous opportunities and introduced sophisticated technological solutions for analyzing gameplay data. (Mäntymäki, Hyrynsalmi and Koskenvoima, 2019, p. 11.)

It is notable that most research on analytics does not address development activities or the importance of different aspects of gameplay. This community's very strong focus on free-to-play games is not visible in other communities, something highlighted by Alha (2019). Alha was also involved in one of the few studies of free-to-play games that, conducted outside the business area, interviewed developers (Alha et al., 2014).

Although the vast majority of studies focuses on retention analytics, there are some (e.g. Su, Backlund and Engström, 2020; Lin, Bezemer and Hassan, 2018; Dheandhanoo, Theppaitoon and Setthawong, 2016) that involve aspects that have traditionally been handled by publishers (e.g. marketing, community management and release strategies). Via analysing data from the Steam distribution platform, Lin, Bezemer and Hassan (2018) study the *early access* release strategy. They find that 15% of the games on Steam use this model and that the vast majority of said games are from independent developers. Via analyses of release notes, reviews and community discussions, they show that this release strategy can be useful for small studios, but should not be used as a main funding source. In the early access phase, community feedback is geared more towards qualitative rather than quantitative ratings. There is also no need to rush into releasing a game:

It appears that the tolerance of players is not correlated with the length of the early access, though other factors might be at play,

5.3 Publishing and analytics

such as the budget and funding of their games. (Lin, Bezemer and Hassan, 2018, p. 791.)

There is a relatively broad geographical representation in the publishing and analytics research. North America, Europe and Asia are all strongly represented. There is also quite a wide mix of studies from small independent studios to major AAA companies.

5.3.2 Recommended reading

This is a must-read for anyone interested in game publishing and analytics research:

- Mäntymäki, M. et al. (2019). “How do small and medium-sized game companies use analytics? An attention-based view of game analytics”. In: *Information Systems Frontiers*, 22, pp. 1–16. DOI: 10.1007/s10796-019-09913-1.

For those who wish to continue reading about game publishing and analytics research, I recommend the following articles:

- Hullett, K. et al. (2011). “Data analytics for game development (NIER track)”. In: *ICSE Conference Proceedings*. IEEE, pp. 940–943. DOI: 10.1145/1985793.1985952.
- Lassila, E. M. et al. (2019). “Visualising a ‘good game’: Analytics as a calculative engine in a digital environment”. In: *Accounting, Auditing & Accountability Journal*, DOI: 10.1108/AAAJ-11-2017-3252.
- Lin, D. et al. (2018). “An empirical study of early access games on the Steam platform”. In: *Empirical Software Engineering*, 23 (2), pp. 771–799. DOI: 10.1007/s10664-017-9531-3.
- Su, Y. et al. (2020). “Business intelligence challenges for independent game publishing”. In: *International Journal of Computer Games Technology*, 2020, DOI: 10.1155/2020/5395187.
- Park, K. et al. (2017). “Achievement and friends: Key factors of player retention vary across player levels in online multiplayer

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games”. In: *WWW Conference Proceedings*, pp. 445–453. DOI: 10.1145/3041021.3054176.

5.4 Other aspects

Here, this book focuses on the development team and how it approaches development. Said approach may be “reductionistic” (Ruffino, 2013), i.e. it may not consider the larger, surrounding system. This latter may include the wider economic structures that strongly influence all developers. It is common for games to be studied at higher levels than the studio. For example, a lot of attention has been paid to: studies of the game industry in different regions; studies of creative cities; and, business studies that look at not only the entire value chain from hardware to retail, but also supporting industries (game journals, etc.). *Political economy*, is distinct from traditional economics in that it focuses on power and inequality aspects (Kerr, 2006). Although politico-economic factors and power structures obviously have a great impact on studio operation, these aspects of game development are not covered here. This is not to say that they are not relevant to game research, simply that they are outside the scope of this book.

5.4.1 Recommended reading

For readers interested in exploring the bigger development picture, I recommend the following sources:

- Zackariasson, P. and T. L. Wilson (2012). *The Video Game Industry: Formation, Present State, and Future*. Routledge. ISBN: 9781138803831.
- Keogh, B. (2019). “From aggressively formalised to intensely in/formalised: Accounting for a wider range of videogame development practices”. In: *Creative Industries Journal*, 12 (1), pp. 14–33. DOI: 10.1080/17510694.2018.1532760.
- Kerr, A. (2017). *Global Games: Production, Circulation and Policy in the Networked Era*. Routledge. ISBN: 9780415858878.
- Kerr, A. (2006). *The Business and Culture of Digital Games: Gamework and Gameplay*. Sage. ISBN: 9781412900478.
- Dyer-Witheford, N. and G. De Peuter (2009). *Games of Empire: Global Capitalism and Video Games*. University of Minnesota

Press. ISBN: 978-0-8166-6611-9.

- Izushi, H. and Y. Aoyama (2006). “Industry evolution and cross-sectoral skill transfers: A comparative analysis of the video game industry in Japan, the United States, and the United Kingdom”. In: *Environment and Planning A*, 38 (10), pp. 1843–1861. DOI: 10.1068/a37205.
- Ernvist, M. and P. Ström (2018). “Differentiation in digital creative industry cluster dynamics: the growth and decline of the Japanese video game software industry”. In: *Geografiska Annaler: Series B, Human Geography*, 100 (3), pp. 263–286. DOI: 10.1080/04353684.2017.1423506.
- Chung, P. and A. Fung (2013). “Internet development and the commercialization of online gaming in China”. In: *Gaming Globally: Production, Play, and Place*. Ed. by N. B. Huntemann and B. Aslinger. Palgrave Macmillan, pp. 233–250. DOI: 10.1057/9781137006332_17.
- Siemiatycki, E. et al. (2016). “Trouble in paradise: Resilience and Vancouver’s second life in the ‘new economy’”. In: *Urban Geography*, 37 (2), pp. 183–201. DOI: 10.1080/02723638.2015.1068526.

5.5 Forums for management and business game research

Game development research in the management and business communities appears to be published almost exclusively in journals that have a clear focus on organisations and management. Consequently, titles such as *International Journal of Innovation Management*, *International Journal on Media Management, Industry and Innovation* and *Organization Science* are represented in the references identified in this chapter.

Industry and Innovation states the following in its aims and scope section:

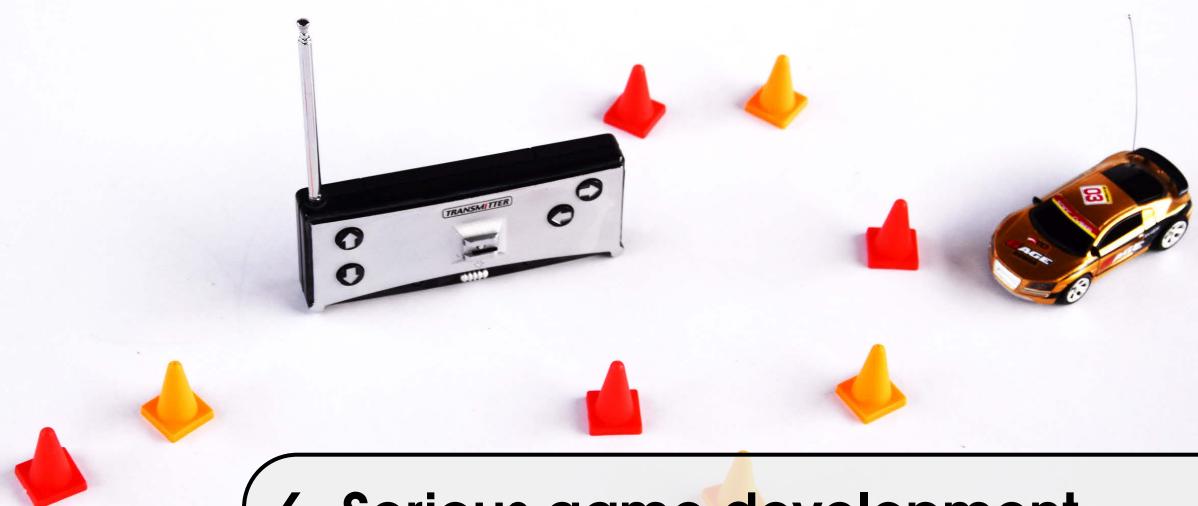
Interdisciplinary in nature, *Industry and Innovation* is informed by, and contributes in turn to, advancing the theoretical frontier within economics, management, sociology, and economic geography. (Taylor & Francis, 2020b.)

Games are not mentioned explicitly anywhere in the said section. The same applies to the *Organization Science* journal which:

publishes fundamental research about organizations, including their processes, structures, technologies, identities, capabilities, forms, and performance. Research from different disciplines, such as organizational behavior and theory, strategic management, psychology, sociology, economics, political science, information systems, technology management, communication, and cognitive science, is represented in the journal. (Informs, 2020.)

In general, games are not highlighted in the journals focusing on management and business. The closest we get is a focus on innovation and creativity.

The lack of focus on games in these fields makes it difficult to identify forums for publication of game development research. In the literature reviews I have conducted, no management or business journal stands out as the primary forum for game-related research. It appears that management and business research on game development is scattered over a large number of journals.



6. Serious game development

As pointed out in the introduction, this book uses *serious games* as a collective term. It includes all approaches that use games or game design for functional purposes. Serious games, educational games, gamification and similar concepts have received a lot of research attention since the '70s. Despite this great interest, such games have not had a huge impact on society. Few serious game companies have been successful¹. Even if a serious game company is successful, it does not automatically mean that their developed games provide an interesting experience. The commercial success of a serious game company may not necessarily be attributable to the developed games attracting player interest. It may simply be that the company was able to attract and satisfy clients. Attracting the interest of those who pay is more important than pleasing those who play. When browsing Google Play, it is sometimes painful to read the download count for serious games that companies have developed with funding from other organisations.

Although the reasons for this lack of success can be discussed, the

¹ One of the many unsuccessful serious game companies was *Sevenatus* (2007 – 2012), which I co-founded with three colleagues. Despite successful results both clinically (Slijper et al., 2014) and as a gaming experience (Taylor et al., 2009) our attempts to commercialise a stroke rehabilitation console were unsuccessful.

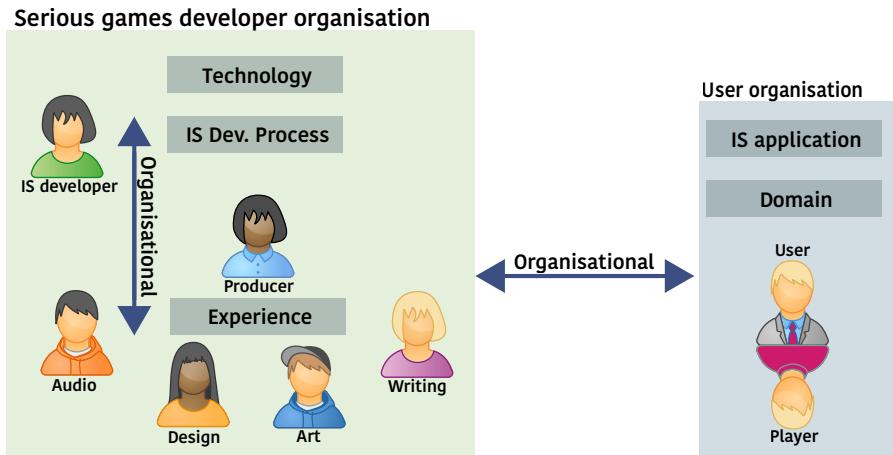


Figure 6.1: A typical serious game development scenario.

failure is, in itself, a clear warning. Research results based on serious projects where the games have excited very little player interest should not be applied to game development in general. This is particularly true if a game was never made available outside its research context. Evaluating the qualities of such games is very difficult. The term serious games is, perhaps, an oxymoron. It is indeed hard to combine a serious goal and maintain the nature of games. I argue that serious game development should be regarded as a combination of game development (figure 2.2) and development of information systems (figure 2.1). The result is a highly complex scenario (figure 6.1) in which developers need to incorporate an organisational aspect and where the target audience has a dual role as both a user (from an organisational perspective) and a player (from a game perspective).

This chapter highlights research projects that study the development of games that have had some success combining the two. The current section mainly presents studies of educational games. While the serious game area contains other types of applications, there is a lack of research on the development of such applications in the wild.

6.1 Research overview

Quite a number of studies propose methods or strategies for serious game development. Most of these studies are based on a single case or use a single case to illustrate the usefulness of the proposed methods. Said cases vary from relationship and sex education (Arnab and Clarke, 2017), literacy (Guardiola and Czauderna, 2018), Euclidean division (Alaoui et al., 2020) to the training of levee patrollers (Harteveld et al., 2010). To this list, I might as well add my own study of the development of a game teaching confirmands about the Old Testament (Engström et al., 2011).

Based on these single case studies, the usefulness of the above-mentioned proposals is hard to evaluate. However, compared to the number of serious games that are developed and actually used, the number of these methods/strategies is striking. One of the most extensive of the aforementioned proposals comes from Arnab and Clarke (2017). Combining frameworks and methodologies from four different application areas, they create a transdisciplinary hybrid. One component in said hybrid is the *Mechanics Dynamics Aesthetics* (MDA) framework (Hunicke, LeBlanc and Zubek, 2004). This comes from the game design area. Yet another is the four-dimensional framework (De Freitas et al., 2010) for evaluating serious games and analysing their design. Finally, there are two frameworks that were incorporated for those development processes that comprise pre-production, production and post-production phases. In one case study, this complex method was used to develop a learning game. However, this latter was only evaluated with respect to the serious goals and the results did not show any clear advantage of using a game rather than traditional teaching. This led the authors to conclude:

The findings based on the evaluation emphasise on the complexity of the subject matter and that there should be more iteration to be done to the game to take into account the pre- and post-game knowledge and attitude of the learners. (Arnab and Clarke, 2017, p. 297.)

There was no evaluation of the actual development process or the user

gaming experience. Use of the MDA framework was considered to guarantee a good gaming experience:

Consulting the MDA provided user experiences that matched the intended delivery methods, allowing for a game to be compatibly designed alongside the pedagogic objectives set out. (Arnab and Clarke, 2017, p. 302.)

It should be noted that MDA is a game design conceptualisation that aims to: “Bridge the gap between game design and development, game criticism, and technical game research” (Hunicke, LeBlanc and Zubek, 2004, p. 1). However, it does not provide any mechanisms for evaluating gaming experience (or guaranteeing the success of this latter).

There is a general lack of studies that, without strong intervention by researchers, evaluate the usage of serious games in a naturalistic organisational context (Backlund et al., 2017). As highlighted by Passarelli et al. (2020) in an interview study of social science researchers and developers, there is also a general gap between researchers and applied game development. To a large extent, researchers focus on serious games and this is also their only contact with the game industry:

Experiences of joint collaborations between research and game industry reported by participants were exclusively related to serious games, and had either started out as pure research projects, or, alternatively, as European/regional projects explicitly conceived to develop a serious game through cross-collaborations between academic and industrial entities. (Passarelli et al., 2020, p. 6.)

The developers, however, reported that they found this work to be hard to transform into something useful:

The interviews with developers, meanwhile, demonstrated that developers found it difficult to identify the practical applications of much social sciences research, especially from a market perspective. (Passarelli et al., 2020, p. 7.)

This illustrates that there is a significant distance between the serious game research community and applied game development.

6.1 Research overview

Holvikivi, Juurola and Nuorteva (2018) present an interesting approach to bridging the gap between developers and researchers. Examining the *Edudigi project* (a platform for collaborative development of educational games with stakeholders from universities, primary schools, game companies and science centres), they identify a number of challenges for collaboration such as: “Different timespan and periods of activity in educational institutions and private companies” (Holvikivi, Juurola and Nuorteva, 2018, p. 9.); privacy and intellectual property rights; and, different stakeholder views of the roles of games in education. Different views are maybe the most fundamental gap where:

Game developers seek to create games that are addictive and fun whereas educators want tools that support curriculum goals and enhance learning. (Holvikivi, Juurola and Nuorteva, 2018, p. 9.)

This mirrors the observations made above.

Most research on serious game development is conducted within the context of (publicly funded) research projects. This entails conditions that are fundamentally different from those in projects that follow commercial principles. Holvikivi, Juurola and Nuorteva (2018) highlight this:

Most of the above-mentioned free games had been developed in some project with public funding. Unfortunately, the development and maintenance of the game usually stops when project funding ends, and the products soon disappear from the market. (Holvikivi, Juurola and Nuorteva, 2018, p. 5.)

Along with Ruggiero and Watson (2014) and Tran and Biddle (2008), the cited study is one of the few to include empirical data from commercial serious game development. Ruggiero and Watson (2014) asked 22 game designers their views of educational game design. Here, with the background argument that: “Research has demonstrated that the carrot and stick approach of educational game design is not effective” (Ruggiero and Watson, 2014, p. 473.), one focus was how designers got players to reflect on their experience. This article interestingly observes that asking designers to present their processes is problematic: “It’s all tied together, the algorithms dictate the content, but we decide the

process” (Ruggiero and Watson, 2014, p. 478). Despite this, the authors find strong indications that a common theme in the responses is the plasticity of the process and that development is an ongoing, upward spiralling process.

There is a strong European domination in studies of serious game development. Case-study is the dominant method. Most often, it relates to proof-of-concept studies conducted by the researchers themselves. This risks a self-confirmatory bias, i.e. researchers having personal interests in showing the benefits of their game or method. Very few studies analyse games or game development in which researchers are not personally invested.

A lot of the research of serious games does not give clear evidence that it involves games that would be popularly regarded as such. There is rarely evidence that the developed game attracts the interest of players.

6.2 Recommended reading

This is a must-read for anyone interested in serious game development research:

- Ruggiero, D. and W. R. Watson (2014). “Engagement through praxis in educational game design: Common threads”. In: *Simulation & Gaming*, 45, pp. 471–490. DOI: 10.1177/1046878114553570.

For those who wish to continue reading about serious game development research, I recommend the following articles:

- Holvikivi, J. et al. (2018). “Collaboration platform for public and private actors in educational games development”. In: *OCCE Conference Proceedings*. Springer, pp. 141–150. DOI: 10.1007/978-3-030-23513-0_14.
- Passarelli, M. et al. (2020). “The distant horizon: Investigating the relationship between social sciences academic research and game development”. In: *Entertainment Computing*, 34, pp. 1–8. DOI: 10.1016/j.entcom.2020.100339.
- Harteveld, C. et al. (2010). “Balancing play, meaning and reality: The design philosophy of LEVEE PATROLLER”. in: *Simulation & Gaming*, 41 (3), pp. 316–340. DOI: 10.1177/1046878108331237.
- Arnab, S. and S. Clarke (2017). “Towards a trans-disciplinary methodology for a game-based intervention development process”. In: *British Journal of Educational Technology*, 48 (2), pp. 279–312. DOI: 10.1111/bjet.12377.
- Tran, M. Q. and R. Biddle (2008). “Collaboration in serious game development: A case study”. In: *Future Play Conference Proceedings*. ACM, pp. 49–56. DOI: 10.1145/1496984.1496993.

6.3 Forums for serious games development research

There is major interest in research into serious games (gamification included therein). This implies that there is room for many forums (journals, conferences, etc.) publishing such research. Most of the conferences and journals listed in previous chapters accept research that includes serious aspects of gaming. In addition, there are forums that have an explicit focus on serious applications. These latter are sometimes narrowed to specific fields such as games for health or educational games.

As this book focuses on game development in the wild, the number of relevant forums is limited. The oldest and most prestigious journal publishing serious games research is *Simulation & Gaming* (Sage, 2020c). Although it has published articles centred on regular games, its focus is: “... exploration and development of simulation/gaming methodologies used in education, training, consultation, and research” (Sage, 2020c.).

Another journal that has published articles highlighted in this chapter is the *British Journal of Educational Technology* (Wiley, 2020). As the name suggests, this journal focuses on technology that supports education and, for example, how the introduction of digital tools leads to improvements of formal and informal education programmes. Hence, this is not a journal that is specifically focused on games.

The *International Journal of Serious Games* publishes articles that address: “theoretical, experimental and operational aspects in the areas related to design, development, engineering, deployment and assessment of digital Serious Games.” (Society, 2020.) However, despite the journal’s explicit focus on development, there are very few articles presenting empirical data from applied serious games development in the wild. *EAI Endorsed Transactions on Serious Games* (EAI, 2020) is another journal focusing on serious games. It highlights technology and tools for serious games, but does not have an explicit focus on development.

The papers identified in this chapter were published at several different conferences. *Open Conference on Computers in Education* (OCCE),

6.3 Forums for serious games development research

Future Play and Conference on Games and Virtual Worlds for Serious Applications (VS-GAMES) were three of these. There are probably many more examples of such conferences, but there is no clear candidate for a forum that focuses on serious games development.



7. The game industry perspective

As should be clear from previous chapters, game development in the wild has not been studied intensively by researchers and there are many areas where there are clear gaps. This chapter aims to provide pointers to resources that lie outside strictly academic research. To fill the gaps in research and better understand game development, there is great incentive for students and academics to investigate these industry-oriented forums.

Hugely successful in creating games that have attracted millions of users, the game industry has grown to be an important part of the entertainment industry. Variations in hardware, genres and content are huge and, perhaps, symptomatic of the expansion over the past 50 years or so. It is clear that said expansion has involved a large amount of development and research in game companies. Makarovych et al. (2018) pointed out the foregoing at an artificial intelligence conference:

The vast majority of the research being conducted takes place in the industry, and only limited portions of this is publicly available [...] While this is arguably exciting, it also means that situating research within the state-of-the-art of previous work is challenging at best, notably for industry based research... (Makarovych et al., 2018, p. 1.)

This situation is not unique to the game industry. Major companies in the IT sector have access to resources and data that far exceed what is available to academic institutions.

It is important to note that industry research is not conducted with the same principles as academic research. First of all, companies develop new knowledge and solutions primarily to develop their own business. The majority of results produced in a company are not disclosed to the public. Secondly, the quality standards (e.g. validity and reliability) of such research are as high as the company decides. In particular, there is no need to show that results can be useful to any entity other than the company in question. Finally, this research is funded and controlled by the management of the company. There are no, or very few, opportunities for researchers to question existing norms or to challenge owner interests. There is nothing comparable to academia's principle of *academic freedom*. Yet, it is important to protect this latter. It has the potential to generate research for the greater good rather than for greater quarterly earnings.

Nonetheless, game companies do release and disseminate flows of results via various channels. Individual developers and companies share some of their results and experiences with colleagues and the general public. This type of information is an important resource for industry professionals who want to develop their skills. In the interview study conducted by Passarelli et al. (2020) developers stated that they did not primarily go to academic sources when they wanted updating on social science and innovation. Instead, they went to industry sources such as *GDC Vault* and *Gamasutra*.

Industry sources cannot be used directly as academic results. However, they serve as important sources of information on the game industry's perspective. Researchers can aggregate and analyse data from such sources. This processed information gives a more comprehensive picture and there are many examples of articles that present results from such studies (e.g. Lu, Peltonen and Nummenmaa, 2019; Consalvo and Paul, 2018; Petrillo et al., 2009).

This chapter presents some well-known channels in which game developers share their findings. The list it uses is by no means

comprehensive. It simply reflects the types of sources cited and used in the game development research articles presented in previous chapters¹.

¹ The PhD dissertation of Whitson (2013) is not included in this book's material. However, said dissertation contains a good example of how industry sources have been used extensively in research. For a list of materials used in doctoral research, see appendix C of the dissertation.

7.1 Game Developers Conference

The Game Developers Conference² (GDC) is an industry-oriented forum founded in 1988 by Chris Crawford, author of the first book on game design (Crawford, 1984). Since then, GDC has grown to be the dominant digital game industry forum. Its annual conference attracts a large number of attendees from the game industry and the 2019 programme had almost 20 different so-called tracks with over 700 sessions.

With a clear North American/UK industry perspective, the conference is based in San Francisco and its presentations are exclusively in English. There are GDC events in other continents, but on a smaller scale. GDC is organised by Informa, a multinational business intelligence, publishing and event corporation. In this context, it is interesting to note that the academic publishing division of Informa operates under the name *Taylor & Francis Group* and is one of the major players in academic publishing.

Presenters at GDC are mainly professional game developers representing successful game companies. Although the format can be seen to support a community of practice (Lave, Wenger, et al., 1991) amongst game developers, the GDC resembles an academic conference in that speakers submit proposals that are reviewed by an advisory board composed primarily of industry experts. Reviewing is not double-blind and the “track record” from previous GDC conferences (i.e. the grades given by the attendees) is included in the application. The GDC also has commercial motives that could give rise to conflicts of interest.

GDC is geared towards attendee takeaways. Its presentations focus on sharing experience and presenting novel solutions. In addition to the conference presentations, GDC also has a strong focus on business-oriented activities (e.g. an expo and sponsored events). The core of the GDC is the main tracks held on the last three days. These are preceded by two days of summits and tutorials. There is also a game career program targeted at students.

Figure 7.1 shows the ten biggest tracks and summits in terms of events. The figure shows that the GDC’s focus differs from that in

² The analysis presented in this section is mainly based on Engström (2019b).

7.1 Game Developers Conference

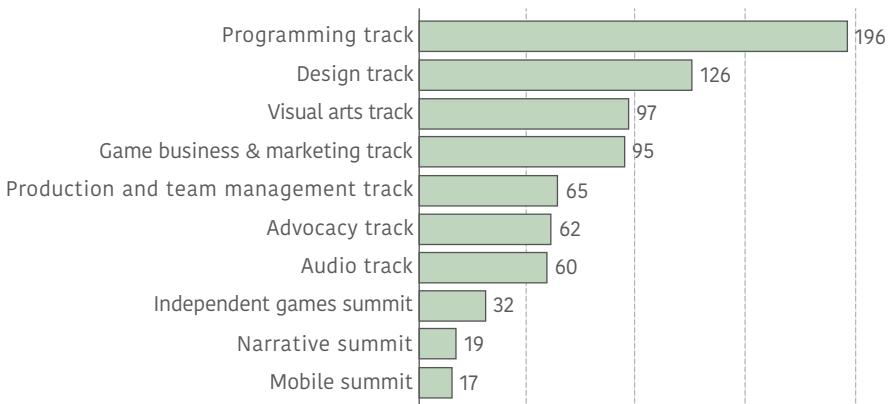


Figure 7.1: The biggest tracks and summits in terms of number of events at the GDC 2019

academic studies of games. For example, the audio track, has three times as many events as the narrative summit. The GDC does not focus solely on content production. It also addresses issues related to management and business. Some of the tracks and summits cover aspects that are applicable across the conference's other areas. Involving (amongst other things) diversity, censorship and quality of life, advocacy is an example here. Figure 7.2 shows a categorisation of the topics covered at GDC-19 (see Engström, 2019b for details).

A presentation at a GDC track or summit is not accompanied by an article or paper. Instead, the slides and recorded presentation are made available in the GDC Vault (Informa, 2020b). Some of these presentations are free, but a membership is required for full access. There are both individual (USD 550 per year) and studio memberships. The charge and the subscriptions are evidence that the industry finds the materials valuable.

The academic world shows little interest in GDC. Scopus returns 152 articles that reference material from GDC Vault. A title-abstract-keyword search for “Game Developers Conference” yields

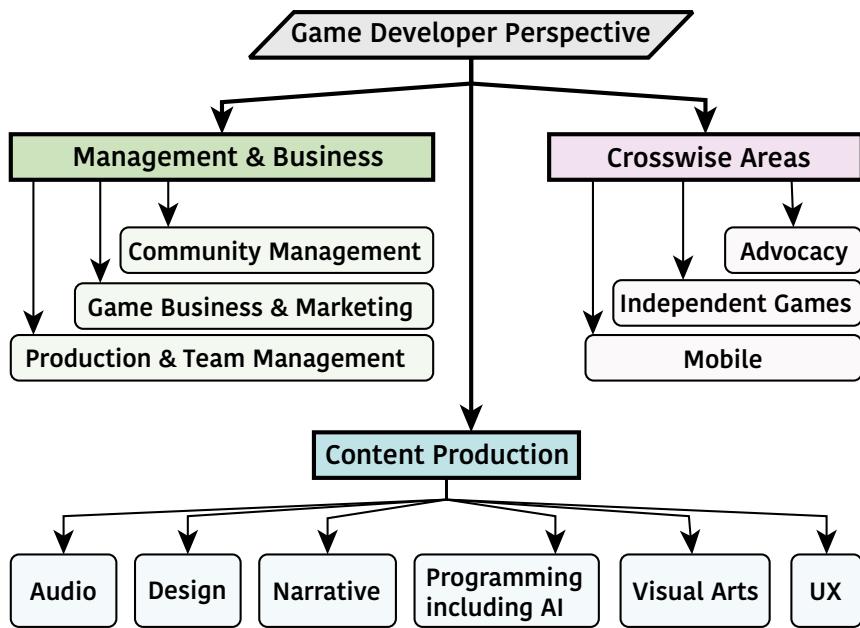


Figure 7.2: A categorisation of the topics covered in the tracks and summits of GDC 2019 (from Engström, 2019b).

7.1 Game Developers Conference

10 hits. These are mostly technical (e.g. SIGGRAPH and Dr. Dobb’s Journal). A notable exception is the frequently cited article by Hunicke, LeBlanc and Zubek (2004) on the MDA framework (which was developed at GDC Workshops). In GDC, the focus on academic research is also limited. Here, the UX Summit is an exception. It mentions “application of research findings” in its description. A search for “game studies” in the GDC Vault returns 10 talks. These are mainly in the Educator Summit, exceptions being four design panels (2006, 2007, 2008, and 2010) with Ian Bogost, Mia Consalvo, Jane McGonigal and Michael Mateas (only 2010). To some extent, the GDC Vault has been used in game development research, but there is great unused potential for more systematic analyses of these presentations.

GDC is not the only industry-oriented conference worth noting. There are many more such conferences and fairs all over the world. Their focuses vary from purely business-to-business to a stronger orientation towards players and other parts of the ecosystem. The following are a few examples: *GameDaily Connect*, previously *CasualConnect* (held in various parts of the world); *Gamescon* (Germany); *IndieCade* (mainly USA); *PAX* (USA and Australia); *Nordic Game Conference* (Malmö, Sweden); and, *Swedish Game Conference* (Skövde, Sweden).

7.2 Gamasutra, 80 Level, Gamer Network and more

In addition to organising GDC, Informa is also in charge of *Gamasutra* (Informa, 2020a), a leading online channel for game industry communication. The site started as the online companion to the printed *Game Developer Magazine* (published between 1994 and 2013). After the magazine was closed down, *Gamasutra* continued to serve as the prime developer-targeted publication. With both GDC and *Gamasutra*, it is clear that Informa has a leading role as a provider of game production information.

Gamasutra is frequently used and cited in academic research, but a title-abstract-keyword search in Scopus returns only three articles. One is a 2008 book chapter on game usability and the other two (Politowski et al., 2016; Washburn et al., 2016) are analyses of postmortems. *Gamasutra* features hundreds of postmortems where developers summarise their experiences of game title development. This data has been used in many studies. In addition to the three articles returned by a title-abstract-keyword search, there is a large number of articles that reference articles published in *Gamasutra*, often written by professionals with experience of a particular topic. *Gamasutra* focuses on providing useful results for professionals³. In addition to the actual article, the associated comment section often has reflections and discussions linked to the topic. This is also a potential source of information for research.

80 Level is a web platform similar to *Gamasutra*. It promotes itself as: “... an industry-leading platform for game developers, digital artists, animators, video game enthusiasts, CGI and VFX specialists” (80 Level, 2020). Despite a clear focus on visual artist areas, it also covers technical and development aspects. The only article I have come across that uses information from *80 Level* is Statham (2020). However, this could reflect *80 Level*’s focus on graphical artists and the general dearth of research focusing on applied game art.

Gamer Network (Reed Exhibitions, 2020) is a UK-based news company that runs news sites such as *Eurogamer* and *Gamesindustry.biz*.

³ An excellent example is the *Game Outcomes Project*, presented by Tozour (2020).

7.2 Gamasutra, 80 Level, Gamer Network and more

The latter focuses on the game industry and has the tagline “The resource for people who make and sell games”. *Eurogamer* features articles related to games and has the tagline “Bad puns and video games since 1999”. It is oriented towards consumers. Both *Eurogamer* and *Gamesindustry.biz* are sometimes cited in research articles. For example, in their discussion of early access publishing, Lin, Bezemer and Hassan (2018) reference the *Eurogamer* article “Valve tightens Steam Early Access rules for developers”.

Another frequently cited source is the gaming news and opinion site *Kotaku* (Gawker Media, 2020). The frequent citing is mainly due to the role *Kotaku* played in the *Gamergate controversy* (Perreault and Vos, 2018).

Polygon (Vox Media, 2020) is a North American based game site that publishes blogs, news and reviews of digital games and other forms of popular culture. Polygon is frequently cited in the texts mentioned in previous chapters (e.g. Drachen, 2015; Parker, Whitson and Simon, 2018).

As mentioned in the introduction to this section, there are many more examples of industry-related sources that have been used in research. In my material, I have come across *MCV/Develop* and *Gamereactor* a few times. It is most likely that there are many similar sources that may be of relevance.

As a research resource, all the examples highlighted in this section have similar characteristics. They feature material that can give valuable insights into the game industry and into game development. However, they are published within commercial structures that often have tight links to the industry they are reviewing. This might lead to a situation where certain businesses may never be critically scrutinised. In some research (e.g. Jørgensen, Sandqvist and Sotamaa, 2017) there is a clear separation in the list of references between research literature, newspaper articles, industry reports and online documents. This is not the case in most research articles, all used material being presented in a single reference list.

7.3 Wikipedia, MobyGames, Twitch and more

Wikipedia (Wikimedia Foundation, 2020) is an excellent resource for information on games, developers and technologies that are not properly documented elsewhere. Several research projects (e.g. Politowski et al., 2018; Kolen et al., 2018; Toftedahl and Engström, 2019) have used it for such data. In some educational contexts, the use of Wikipedia as a reference is questioned. Yet, as pointed out by Kultima (2015, p. 23), the banning of Wikipedia in student essays could make it very hard to cite game-related information.

MobyGames (Blue Flame Labs, 2020) is a credits database for games (similar to IMDB for movies). It presents the names and roles of the people that have been involved in the production of game titles. The data in *MobyGames* has been used in some research studies (e.g. Dezso, Grohsjean and Kretschmer, 2010; Pottie-Sherman and Lynch, 2019; Bailey, Miyata and Yoshida, 2019). To determine the gender distribution in different roles and how it has developed over time, one study (Bailey, Miyata and Yoshida, 2019) interestingly analyses credit lists in *MobyGames* in combination with the site *genderize.io*. They conclude:

Although the gender gap in game development has improved over time, it is still far from representing the gamer population, and the wage gap is likely to be even more difficult to close given the disparities present in high-paying roles and leadership. (Bailey, Miyata and Yoshida, 2019, p. 21.)

This is an example of how game development can be creatively studied without leaving the desk.

YouTube (Google, 2020) and other streaming platforms contain huge amounts of information about games and gameplay. Material on developers' processes and intentions can also possibly be found. Besides interviews and presentations, this may be material provided by developers themselves. Ellmann et al. (2017) highlight the presence of *software development screencast* and how it can be used to analyse developer practice. Although not specifically targeted at games, this study illustrates the potential of YouTube as a source of developer

7.3 Wikipedia, MobyGames, Twitch and more

information. While primarily used to stream gameplay, *Twitch* (Amazon, 2020) is also used to stream game development. One example of this is the Dutch developer *Vlambeer*. It attracted 12,000 paying subscriptions to its development channel (Wikipedia contributors, 2020).

One very specific source relevant to the video and streaming sources above is the documentary *Indie Game: The Movie* (Swirsky and Pajot, 2012). This 2012 film gives a close insight into the creative processes behind the indie games *Super Meat Boy*, *FEZ* and *Braid*.

Reddit (Advance Publications, 2020) is a forum that contains discussions about more or less everything. Game development is represented via a number of subreddits. There is also a huge community devoted to games and gaming. This provides researchers with a source of relatively uncensored opinions on various aspects of games and game development. It has been used in several studies (e.g. Consalvo and Paul, 2018; Joseph, 2018; Lu, Peltonen and Nummenmaa, 2019). An analysis of indie developer practice and mod makers' attitudes towards commercialisation of their creations is an example of one such study. The amount of data on Reddit allows for quantitative text-mining studies. Several qualitative approaches have also been used.

In addition to Reddit, there are discussion forums focused on games and game development. The *Independent Gaming Source* (TIGSource) is a “community of independent game developers and players” (TIGSource, 2020.) This also hosts *TIGForum*.

7.4 International Game Developers Association

In 1994, Ernest Adams, co-author of one of the most popular game design books, founded the International Game Developers Association (IGDA). The organisation states that: “Our mission is to support and empower game developers around the world in achieving fulfilling and sustainable careers” (IGDA, 2020).

IGDA aims to serve as a professional organisation for game workers. It is organised in chapters for different regions and interest groups oriented towards special areas in game development. As regards local chapters, there is a strong representation in North America (50 chapters). There are some chapters in Europe⁴ and South America (10 – 20 each), but relatively few in Asia and Oceania (10 chapters altogether) and very few in Africa and the Middle East (5 chapters in total).

The interest groups are clustered in three main topics, namely, *Advocacy*, *Discipline* and *Affinity*. These have the following groups:

- **Advocacy Interest Groups:** Allies; Anti-Censorship and Social Issues; Climate; Developer Credit; Game Accessibility; LGBTQ+; and, Mental Health.
- **Discipline Interest Groups:** Analog Games; Audio; Business and Legal; Community Management; Free and Open Source Software; Game Art; Game Design; Game Education; Game Writing; Games Research and User Experience; Human Resources; Learning, Education, and Games; Localization; Quality Assurance; Real Money Gaming; Romance and Sexuality; Serious Games; and, Virtual, Augmented, and Mixed Realities
- **Affinity Interest Groups:** Blacks in Games; Devs with Kids; Games for Health; Indie; Jewish Game Developers; Latinx in Games; Student; Unity; and, Women in Games.

Not all of these interest groups appear to have an active community (at least, not based on the activity in their social media accounts). However, the channels used for the main IGDA organisation are active with a lot of

⁴ The Finnish IGDA chapter has been analysed by Komulainen and Sotamaa (2020).

7.4 International Game Developers Association

events, livestreams and other activities.

IGDA publishes reports addressing various issues of the gaming industry. This includes a biannual *Developer Satisfaction Survey* and a *Diversity in the Game Industry Report*.

7.5 Books with industry sources

Regard for books varies significantly between different disciplines. In humanities and social science, books can be the main dissemination channel for academic work. In other communities, books rarely replace journal articles or even conference papers. It can be very hard to determine the academic merit of a book by simply looking at the cover. To some extent, the publisher can be an indication. However, publishing is largely a commercial business. This introduces forces other than the need for quality. It is possible to publish a book that has not passed the eyes of any peer expert and, in some cases, not even the eyes of an editor. Books are predominantly reviewed after release. Many journals publish book reviews, in addition to original research. If a book gets many citations, it can be seen as a retrospective acknowledgement of its importance.

This book⁵ references book chapters that are indexed in the Scopus database (which gives some level of quality assurance). With the exception of the game design books presented in section 3.2.1, all other books have been excluded. As discussed in that section, these books do not qualify as research in most contexts, but have been cited and used so frequently by game researchers that they can be considered part of a *canon* (Kultima, 2015). This is why they are included in the chapter presenting game design research.

There are several other books that include industry sources or present experiences from game production in some way. As for the game design books, some may qualify for inclusion in the canon of game research while others may not. These latter may still be useful as data sources (comparable to the sources discussed previously in this chapter). Many such books focus on specific crafts in game development (e.g. AI, 3D modelling or game writing). When cited in research, such books may constitute a source of information comparable to the other sources discussed in this chapter.

Below, there is a list of books containing useful empirical data and

⁵ I am fully aware that the present book would not, in itself, qualify for inclusion.

7.5 Books with industry sources

insights from game development on a more general level. In some cases, the books have been authored by researchers whose work is cited in the previous chapters.

- Ramsay, M. (2012a). *Gamers at Work: Stories Behind the Games People Play*. Apress. ISBN: 978-1-4302-3352-7.
- Ruggill, J. et al. (2016). *Inside the Video Game Industry: Game Developers Talk about the Business of Play*. Routledge. ISBN: 978-0-415-82828-4.
- O'Donnell, C. (2014). *Developer's Dilemma: The Secret World of Videogame Creators*. MIT press. ISBN: 9780262028196.
- Taylor, T. L. (2012). *Raising the Stakes: E-sports and the Professionalization of Computer Gaming*. MIT Press. ISBN: 978-0-262-01737-4.
- Arsenault, D. (2017). *Super Power, Spoony Bards, and Silverware: The Super Nintendo Entertainment System*. MIT Press. ISBN: 9780262341493.

In addition to these specific examples, MIT Press has a *platform studies* series⁶ that includes several books, each of which highlights specific gaming hardware.

⁶ The books in this series can be found through this web page: <https://mitpress.mit.edu/books/series/platform-studies>.

8. Discussion

As pointed out in the introduction, game development covers all the KCC's four modalities of human creativity, i.e. science, engineering, design and art (see figure 1.1). Hence, it is not surprising that there is great variation in the type of research addressing said development. This chapter returns to the "big picture" and highlights some themes running through the previous chapters.

The first two subsections of this chapter address fundamental differences between researchers and types of research. These differences are hard, if not impossible, to bridge. They are represented by the highlighted elements of the KCC in figure 8.1.

The first aspect addressed in this chapter is the gap created by differences in scientific paradigms. To a large extent, this gap runs along the vertical line between culture and nature in figure 8.1. Section 8.1 discusses the implications of this paradigm gap.

The second aspect addressed in this chapter is the combination of the gaps between, on the one hand, production and perception and, on the other, applied and non-applied research (see figure 8.1). Non-applied research (basic or fundamental) is typically oriented towards a single discipline and addresses fundamental questions within this discipline. Applied research focuses on concrete problems and typically involves

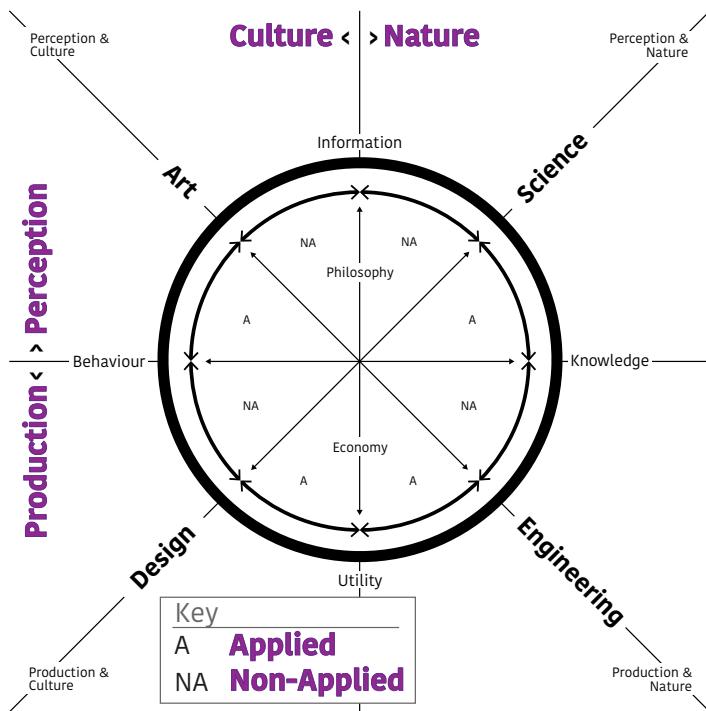


Figure 8.1: The KKC (see figure 1.1 for details) with components highlighted for the purpose of the discussions in this chapter.

aspects from several disciplines. The production-perception gap in figure 8.1 can be seen as the distinction between creating new solutions and observing and interpreting existing phenomena. Section 8.2 combines the aforementioned two gaps and analyses how all four different combinations of production, perception, applied and non-applied can be observed in game research.

In section 8.3, I address some other themes touched on in the material in previous chapters. These are themes that run across disciplinary boundaries.

Finally, in section 8.4, I draw some conclusions with respect to the main goal of this book.

8.1 The paradigm gap

As pointed out in the introduction, interdisciplinarity is probably not the path to pick if the goal is a successful academic career. Careerists should focus on one discipline with a well-defined community. The majority of game researchers are not evil careerists but, being strongly interested in their own tradition and discipline, simply want to explore a specific path. Gaining deep understanding of a specific aspect may require the overlooking of most other paths. To create a photo-realistic model for a game, a scientist may devote a great deal of time to analysing the reflection of light in coffee. This does not necessarily require an understanding of how the music score affects the emotional experience of the game. If the focus is on understanding and recreating reflections of light, it makes sense to lean towards the right side of the KCC.

Similarly, a media study scholar may analyse to what extent places are perceived as meaningful to players of *Everquest*. This does not necessarily require an understanding of the network communication protocols used. When the focus is on human experience and representations of culture, it makes sense to lean towards the left side of the KCC.

It is not a problem that some research focuses on a specific aspect of games and game development. However, it becomes a problem when this single perspective is extrapolated to make claims for situations where other aspects are equally important. The *law of the instrument*, or Maslow's hammer, is a good metaphor for what this attitude can lead to: if all you have is a hammer, everything looks like a nail. The challenge is for the hammer holder to acknowledge other tools.

Game studies was established as an attempt to gather all scholars interested in games under one umbrella. As pointed out by Deterding (2017), this has not been possible. Deterding presents a critical reflection of the game research landscape and makes several observations that give perspective to, and understanding of, the challenges of interdisciplinary research. At the most fundamental level, some differences between

groups of researchers are hard to bridge. The paradigm gap is one such example. Collaborating with someone who has the goal of finding the truth is a major challenge if it is believed that everything is in the eye of the beholder. Of course, this applies in both directions.

A positivistic approach will be met with scepticism in some conferences, while critical theory will not be appreciated in others. Academic communities are formed through social mechanisms and many academics stick to a community with a shared ontological view. This makes research and the associated social interaction much more frictionless. These differences go beyond academic aspects and includes political and philosophical dimensions. This is apparent when studying articles from different disciplines. The language and focus are notably different in, for example, software engineering compared to game studies. The political and societal dimensions are typically not addressed in the former while terms like “Marx” and “capitalism”, are relatively frequent in the latter.

Differences such as these make collaboration between disciplines challenging and full of friction. The easy solution is to avoid tight collaboration and work solely within the “home discipline”. This luxury is not available to game developers. Game developers with different backgrounds have to collaborate and resolve conflicts rooted in differences like the one discussed above. In contrast to academics, they do not have the choice of working individually. They have to create one game together. The value of an understanding between groups is highlighted in many studies of game development:

Without engineers who interface well with designers and artists, the result is technologies that do not bridge these ways of understanding the world; they merely reinforce the old ways.
(O'Donnell, 2009, p. 17.)

The paradigm gap runs deep into our culture and society. In many countries, students more or less have to choose between humanities or technology (culture or nature) at an early stage in their educational programmes. For example, it may be difficult for an upper-secondary student to specialise in both art and programming. I have come across

8.1 The paradigm gap

many humanities-focused people who almost brag about their lack of skills in maths. I have also participated in lunch conversations with engineers who seem not to care at all about theatre, literature or even music¹. This dichotomy between humanities and technology is problematic for studies of game development.

Digital games are born from the marriage between: technology and art; rules and play; and, sense and sensibility. All these perspectives are needed to understand the birth process. I would argue that the dichotomy between technology and humanities is socially constructed. Most children enjoy both rhyming and counting. They enjoy both crayons and Lego. They both sing and knock down Kapla towers with equal enthusiasm. Talents for different things are not evenly distributed, but there is no need to force people to choose “sides”. I consider myself to be non-binary when it comes to humanities and technology. I am definitely of the opinion that game developers benefit from transcending the fictional boundary between the two.

¹ Possibly with the exception of heavy metal.

8.2 Types of research

I argue that there are two aspects of research that run orthogonally through the disciplines and which, because they have important implications as to the characteristics of the research, deserve highlighting. Figure 8.2 illustrates a proposed space for empirically grounded game development research.

The first research characteristic relates to the focus of the study (the horizontal axis in figure 8.2). Even if research includes empirical data from game development or makes claims about game development, the focus can still be dominated by disciplinary perspectives (left side). In such studies games can, for example, be seen as one of many application areas. There is little or no interest in the complete game development situation. The main goal is to contribute to a specific discipline. This is often basic research (or non-applied as shown in figure 8.1). At the other end of this spectrum (right side), the focus is on game development. Research is approached as an activity in its own right and acknowledges its many dimensions and the contradictory goals. In this type of research, game development is frequently characterised as a wicked problem (Buchanan, 1992). The goal of such research is to contribute to game development. This corresponds to applied research as shown in figure 8.1.

The second characteristic of research relates to if it is focused on observing others (the lower half of Figure 8.2), or if the researchers are included themselves in the development (the upper half). This divide can be observed in most disciplines and relates to the tension between theory and practice (or production vs. perception as shown in figure 8.1). Different communities use different terms. *Practitioner research* is a research model where practitioners are using their professional practice as a basis for conducting research (Allwright, 2005). This is, for example, used in teaching, nursing, and psychotherapy research. In design theory there is a distinction between *research about design* and *research through design* (Frankel and Racine, 2010). In ethnographic research there is a debate on how active or passive the researcher should be (Hammersley, 2013). In software development and engineering, it is common that

8.2 Types of research

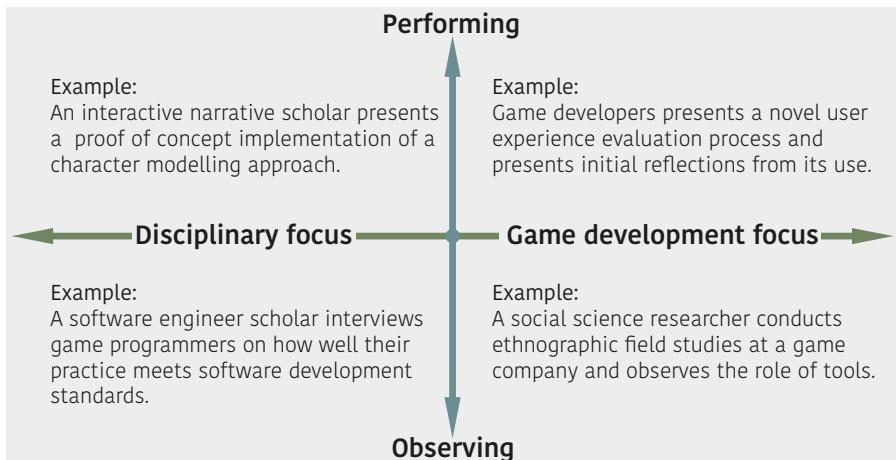


Figure 8.2: A characterisation of empirically grounded game development research. The horizontal axis is the research focus and the vertical axis is the degree of participation in development. The resultant mixes are exemplified with a hypothetical study.

theoretical results is expected to be accompanied with a *proof-of-concept implementation*.

This book focuses predominantly on the right half of figure 8.2, i.e. research concentrating on understanding game development as an activity in its own right. The challenge for the left half is that, when the focus is on something else, there is a risk that it will skew the results in that direction. This is not to say that this type of research cannot be relevant for game developers. In fact, there are examples of relevant studies in all corners of 8.2:

- *Disciplinary focus, performing development:* This corner includes a large part of technical game research. One illustration of this is system development supporting an isolated element (e.g. design, writing or technical aspects) and excluding others (and overall development). One of many possible examples is a study by Deng et al. (2017) proposing heuristics for server allocation in multiplayer cloud gaming. This study may be highly relevant for

game developers, but has a strong focus on cloud computing. Other aspects of game development (e.g. design and art) are not addressed.

- *Game development focus, performing development:* This corner includes studies conducted by researchers participating in game development. There are several examples of studies where at least one of the authors is a developer at a game studio. The study by Walfisz, Zackariasson and Wilson (2006) is a good example of this.
- *Disciplinary focus, observing development:* This corner includes studies where researchers interview or observe developers and focus on a specific aspect of development. An example is the study by Stacey, Brown and Nandhakumar (2007) examining mobile game developers and how they used stories in a project. This study's contribution targets information system development and how the storytelling approach can be used as a tool.
- *Game development focus, observing development:* This corner represents the majority of the studies highlighted in this book. These are mainly interviews with game developers and/or ethnographic field studies at companies. Unlike in the previous corner, research here is focused on game development as a compound activity. These studies acknowledge that developers with different backgrounds and priorities collaborate. Jørgensen (2019), for example, reports a study where ethnographic observations, interviews and review of documentation were used to analyse the operation of a game company.

The above characterisation of development research highlights the fact that there is great variation in the type of research conducted (in addition to the disciplinary breadth shown in previous chapters). Each of the corners has its strengths and benefits. It is hard to argue that some of them are unnecessary. However, I would assert that there is a shortage of studies in the right half, in particular, the upper part thereof. Too many game scholars have not participated in any game development themselves and are more focused on perception than production.

8.2.1 Why should researchers create games?

It can be argued that, if literature scholars do not need to be authors, then why should game scholars need to be developers? However, this comparison does lack some understanding of the fundamental differences between game development and writing. First of all, even non-authors have some experience of the fundamental techniques in putting words on paper. Most probably, everyone has tried writing poems or short stories (e.g. in school). Many people have no experience of game development *at all*. They have not even tried to design a very simple board game. This means that they have not experienced the dynamics that emerge when people interact with a game's designed mechanics. This is an experience that is important for understanding the nature of game development.

On top of this, development of digital games adds an additional level of interdisciplinary collaboration that most people are not exposed to. People with a background in programming may be frustrated by artistic processes that are not captured in Gantt charts. People with a humanities background may be surprised by how long it takes to implement features that appear trivial:

When a game-designer asks a programmer to design an animated ‘rope’ as a decorative object in a virtual setting, he thinks it’s a very simple task and does not understand the rebuttal from the programmer, rather promoting a stick. (Simon, 2006, p. 120.)

This interdisciplinary collaboration and the challenges presented by programming differentiate game development not only from writing, but also from most other media production. For reasons such as these, I argue that there must be no assumption that game development can be understood as easily as other media production. Unfortunately, there are many examples of research studies that do not acknowledge the complex characteristics of game development.

I have met game scholars who are sceptical about colleagues who, not playing any games, still write on the subject. Said scholars argue that game experience is created in the interaction with the game and cannot

be replaced by game observation. While I understand and respect this standpoint, I feel that observing others play is comparable to observing others develop games. The activity can be understood through observations and interviews. However, gaining deep, grounded understanding without first-hand experience may be difficult. Mateas and Stern (2005) make a good argument for the value of applied design experience in game research. Their focus is on narratives in games, but the same arguments also apply to the wider case of game development (not least where financial aspects, e.g. return on investment, cannot be ignored).

To conclude, I do not think all researchers need to participate in development, but researchers observing development can really benefit from having first-hand experience of applied game development (in addition to also being game players).

8.2.2 Who is the author?

The game development process involves many elements of creative work. Developers in all professions state that creativity is an important part of their crafts. Despite the aforementioned collective creativity, it is common to credit a game designer as the mastermind behind the creation. In the studies presented in this book, this perspective is often seen as problematic. Games can evolve organically, their content being shaped by many different professionals. These include not only designers, writers, artists and programmers, but also testers. Some really great gameplay has been discovered through bugs (thus, said gameplay was not an intentional goal). Despite the complexity of the creative processes, it is common for research to study game creativity as an individual process. Studies of collaborative creativity are rare. For example, it is very common for games to include both game mechanics and narratives. Hence, game designers and game writers usually need to merge their creative visions. Despite this very frequent situation, I have found only one article (Linderoth, 2015) that addresses this. One conclusion of this work is:

8.2 Types of research

... video game stories are not created in a vacuum; they always have an integral relation to the game as a whole, gameplay and story have to fit. (Linderoth, 2015, p. 294.)

Numerous studies examine interactive writing or game design in isolation, focusing on each as an individual process. This imbalance is problematic for the understanding of game development.

Many game studies scholars take theories from literature and apply them to games. This makes the game the text and the designer the author. I would argue that, in a game development context, the concept of a single creative author is inappropriate. If the media theories had originated from studies of improvisational jazz, they would probably be more fitting. Band musicians have much more in common with game developers than authors do. This relational view of culture creation is, for example, reflected in the work of Vaan, Stark and Vedres (2015, p. 1146):

We build on this conception of culture, shifting attention from individual deployment to skills that develop in an ongoing dynamic of relations between people.

On this note, we can return to Barthes (1977) and his discussion of the role of the author in relation to the reader. I too would like to see the death of the author, but for a different reason – let us stop focusing on the author and, instead, emphasise the importance of the team. Or, to paraphrase the closing line in Barthes (1977): “The birth of the creative team must be at the cost of the death of the Author”.

8.3 Themes in game development research

Despite the wide variations in perspectives and focuses in the communities that have studied game development, it is possible to identify some themes that cross disciplinary boundaries. This section highlights several such themes.

8.3.1 Project management

Most of the disciplines in previous chapters highlight the challenge of managing game development projects. Management literature mainly addresses this as a problem of managing creativity. To a large extent, the game studies field focuses on the consequences of the management challenge. For example, many studies highlight “crunch-time culture” as problematic, not least in combination with family life (Ahmadi et al., 2019; Harvey and Shepherd, 2017). It is rarely problematised why it is so common for game projects to reach crunch time. The explanation may be more than a failure to appreciate the negative aspects of crunch. Indeed, project managers may know all the downsides but still be unable to avoid them. A simple banning of overtime may be possible for developers with no deadlines and with unlimited resources. In other cases, it may lead to cancellation of projects (Jørgensen, 2019).

Planning and management of game projects can be extremely challenging for a number of reasons. One is that it involves the development of a software system. It is well known in *regular* software development that planning and management is challenging. The solution there has been to introduce engineering methodology with requirement specifications, planning and structure. Despite this structure, there is still an “estimate inaccuracy and time-to-market pressure” (Ferrucci et al., 2013, p. 462). The solution proposed by Ferrucci et al. (2013) is to transform unplanned overtime into planned overtime (eliminating overtime is not considered an option). Game development inherits these challenges, but adds the great uncertainty introduced by the non-utilitarian, experience-oriented nature of games. This requires some space for chaos. It is not obvious how to handle this situation.

8.3 Themes in game development research

In the software-oriented literature on game development, there are several examples where management is highlighted as being different from what it might have been expected to be:

Interestingly, none of the producers had a background in computers or technology: one had an MBA and the others were humanities graduates. (Schmalz, Finn and Taylor, 2014, p. 4327.)

In traditional software companies, there is a clear focus on software development. A majority of the personnel has a background in technology. These companies focus on developing advanced technical systems, hence the gearing towards technology. Thus, it is natural that management is expected to have a similar background and to understand technical problem solving.

Game companies also develop advanced technical systems, but they additionally face challenges related to “soft” problems such as creating an interesting player experience and conveying a cultural message. It appears that, when recruiting managers, many companies do not prioritise technological skills. Some engineers highlight the lack of technically grounded managers as a problem:

Interviewees pointed out that a consequence of non-engineers in management roles is that it is hard in games to communicate engineering issues. (Murphy-Hill, Zimmermann and Nagappan, 2014, p. 6.)

There is also management research showing that artists find engineering planning to be problematic:

It’s hard to get the artists on board with Agile. One of the Agile ScrumMasters is an artist, but he isn’t Agile. That’s a problem. There’s a dual system happening here. (Hodgson and Briand, 2013, p. 320.)

It is clear that game development management requires an understanding of many different perspectives. The literature has several examples (e.g. Cohendet and Simon, 2007; Canheti, Andalo and Vieira, 2018; Whitson,

Simon and Parker, 2018) of the important role the producer plays in bridging differences between groups and creating a shared understanding.

The producer not only bridges differences within the development team, but also acts as a barrier between the team and the wider organisation (where corporate and financial aspects have to be considered): “Often, producers must simultaneously be context managers, negotiators and disturbance handlers” (Cohendet and Simon, 2007, p. 596).

Canheti, Andalo and Vieira (2018) highlight communication skill as one of the most important qualities for handling all the above roles. Producers need to have strong people skills and a basic understanding of all elements in game development. As illustrated in figure 8.3, one of the key tasks of a producer is to get the motley crew of game developers to share a common focus on the game they must jointly produce. How producers manage to do this is not well understood: “Producers typically have a broad and poorly defined skill set” (Schmalz, Finn and Taylor, 2014, p. 4326).

In many ways, the producer is more important than the game designer, but has received much less attention in game development studies. Whitson, Simon and Parker (2018) highlight that many small indie game developers lack a producer, but that producer tasks still need to be performed. Amongst other things, they highlight the importance of having people who can build relationships:

This leads us to posit that the most successful developers are those that master relational labour, that of building and maintaining productive, intimate and seemingly authentic connections with whomever is standing across from them. (Whitson, Simon and Parker, 2018, p. 11.)

Whitson, Simon and Parker (2018) highlight the challenges small indie studios face when, their main focus being to create an interesting game, they are expected to adopt entrepreneurship principles focused on growth and profit. The missing producer would play an important role in addressing this conflict of interests.

8.3 Themes in game development research

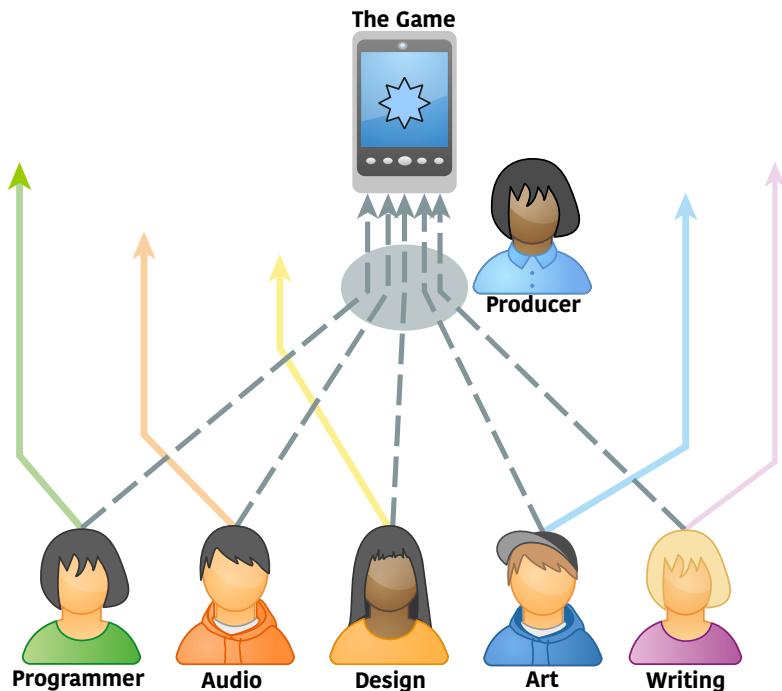


Figure 8.3: In channelling the various focuses of different professions towards a common game-creation goal, producers have an important role.

8.3.2 Technology and tools

From studio studies, it is clear that tools play an important role in the development of games. Though they continue to pose challenges, they also play an important role in shaping the collaboration and the end result:

But, rather than a mutely obedient tool, software exerts agency of its own and is seen to exhibit magical, even agential properties during game development. (Whitson, 2018, p. 2328.)

There are several reports on how tool development is an important activity in supporting production. In one study, a programmer expressed his view:

There's always conflicts between art and engineering. They want tools to work this way. They want to do the minimum work possible. And sometimes we can make that happen by spending a lot of engineering time developing some nice neat tool for them... ; it's purely resource based, so we can save the art team time by spending engineering time and vice versa. (McDaniel and Daer, 2016, p. 160.)

This quote shows a conflict between groups that, although it sounds problematic, reveals an important prioritisation that developers need to address. A studio may devote developer time to tool production and tool customisation. While, this obviously removes resources from game development, it may very well pay off in the total time needed to produce the game. It may also unleash a new creative potential for some developers. A well-designed user-facing tool can, for example, encourage designers to test new ideas.

Although tool production may involve great engineering effort, it certainly also needs contributions from other groups. This is particularly true of user-facing tools. If a tool targets artists, these latter need to be involved in identifying needs and ensuring the new tool interfaces well with existing tools and procedures. The user experience dimension of tools is also very important. Thus, additionally, UX team involvement is probably needed in tool development. The development of tools for game production is actually an example of typical information system

8.3 Themes in game development research

development. Large companies have separate teams for tool and game development. In small companies, developers may have to handle both. It is not clear how they separate these two, quite different development tasks.

The nature of tools affects the nature of the craft. When the main interface in engines was code, there more or less had to be a programmer to design games. With the introduction of high-level tools, this is no longer a necessity and, consequently, other groups can approach game design:

The combination of specialized level-design positions with the availability of level-design tools has made the design process more general and more accessible. This, in turn, has allowed more game players who do not have formal programming training to become designers after receiving on-the-job training. (Tschang, 2007, p. 995.)

This quote illustrates the effects the introduction of level design tools can have on the creative process and how new groups of people can be involved in the creative process. A level design tool is typically oriented towards the geometrical properties of a level and, for example, positions objects and characters in a map. There are several other aspects of games that have not received as much attention and where there is potential for development. In one of the few articles that highlights music in games, Mitchell (2014) describes how music composers' work is done on the outskirts of the game studio. Interestingly, one of the interviewed composers express strong feelings about tools:

But as far as any specific technical tools [go] - we certainly have a lot of them now. If anything I'd like to slow down this technical barrage. (Mitchell, 2014, p. 16.)

However, he is not referring to tools related to integration with the game design. I feel that tools have great unused potential for bringing music and audio production closer to design. Game writing is another area where the processes of writers and the production environment appear to

lack integration. Research on interactive writing has produced advanced tools and systems for writing but, to the best of my knowledge, they are not integrated with other game production systems. One of the very few studies of applied game writing indicates that narratives are not given a very elevated position in the studied companies:

The main results show that the developers do not see storytelling as the defining trait of video games, but as a component in a whole product. (Linderoth, 2015, p. 279.)

There is a need for tools that support writers in their creative processes and also integrate with game mechanic elements (Engström, 2019a).

Technology and tools have played a central role in the evolution of digital games. I see no reason why this will not continue. There is great potential for research to pay closer attention to the creation and use of tools and technology in the game development process. Such research should consider their role from both production and creativity perspectives.

8.3.3 Size and motivations

From the articles presented in previous chapters, it is clear that, compared to production in large AAA companies, game development is different in small independent studios. The scaling from tens of development people to thousands of such people obviously affects work organisation. This has to be considered when discussing development approaches. Different discipline's levels of access to large studios have been previously highlighted. In game studies, several researchers, while focusing on indie development, have bemoaned the lack of access to major game companies. In management and business research, on the other hand, there are many studies that include AAA companies and there is no discussion of the lack of company access.

A possible explanation of this skewness is that critical game studies may have more in common with the alternative indie developers while business researchers may be more positive towards capitalistic business logic and have better links to the management level in companies.

8.3 Themes in game development research

Irrespective of reason, this skewing is unfortunate. It results in an imbalance in the sort of research available for the different company types. Experience from AAA production may be useful in smaller indie contexts. The opposite may also be the case. Indie development has already generated many innovative games and it is possible that there are also innovative development practices that can be identified. AAA production is not perfect:

The default development process in the gaming industry has often led to major player experience problems, a lack of time to address these problems once they're identified, and a lack of flexibility because previous decisions limit options for how to address the issues. (Pagulayan et al., 2018a, p. 308.)

O'Donnell (2009) highlights another problem at a major US company that subcontracts Indian artists to produce game assets. These developers were not getting access to the tools needed to view assets inside the game. This made their work unnecessarily challenging:

I encountered artists struggling to work within the confines of structures unknown and invisible to them because the experimental tools, which would enable them to understand where, how, and why aspects of their work were failing, were withheld by the contracting organization. (O'Donnell, 2009, p. 15.)

As shown by Cohendet and Simon (2016), AAA studios struggle to balance rational production aspects and the need to create new innovative products. This study clearly shows that too rigid production structures can have a severe negative impact on the creative processes:

A key point was that the stage-gate approach was conducive to efficiently producing new games in the ‘more of the same’ manner, but not effective for generating and validating new ideas for ‘disruptive’ games. (Cohendet and Simon, 2016, p. 622.)

Another thing that differs between different studios is the logic driving the companies. While some development is strongly driven by market logic, other development is driven more by the love of games. This divide

largely matches that of company size. AAA companies are strongly commercial while indie developers have other motivations. Many small indie studios do not want to grow beyond a certain size. They want to maintain the type of activity they have and enjoy:

For the developers we talked to, ‘success’ was not vested in the game being produced, nor in individualized metrics of success (critical acclaim, audience reception, sales numbers, average play time and net profit), but in the ability to sustain ongoing creative and collective processes – the social engagement related to both making games together as a team and sharing them with others. (Whitson, Simon and Parker, 2018, p. 6.)

8.3.4 Access and research funding

To be able to conduct industry-oriented research, researchers need access to companies. This is a challenge that needs to be addressed. One part of the problem is the working conditions at many companies (Legault and Ouellet, 2012). These create an environment where any additional tasks may be perceived as problematic. Another challenge for research is the non-disclosure agreement culture that is strong in many companies and which makes it hard to collect and disseminate empirical data: “However, demands for secrecy seem to have taken precedence over the maturation of game development practice” (O’Donnell, 2009, p. 13). Indie game companies may be more open (Consalvo and Paul, 2018), but they may also have differences in scale and maturity. New forms of collaboration between industry and academia need to be established.

Many researchers highlight the problem that access to game companies is poor. This impedes study of how said companies operate. It is interesting to note that this concern is not evenly distributed over disciplines. It appears that the game and media studies communities find getting access more challenging than do the management and business communities. This creates an imbalance between disciplines; management studies are reporting results from AAA development while game studies are focusing on small independent studios.

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An additional challenge for industry-oriented research is the type of research funding available. The research funding agencies are oriented towards existing disciplines. Ito (2017) highlights this in relation to the antidisciplinary movement at the MIT media lab (as discussed in the introduction):

If you work in the white space, you often can't get federal funding, which, in turn, makes it difficult to generate the body of work necessary for tenure in traditional academic departments. (Ito, 2017, p. 23.)

For traditional industries (e.g. manufacturing), there are established research grants focusing on industrial development. Such grants are not readily available for game industry research, at least not in Europe. Funding related to games is almost exclusively focused on areas outside the core industry. Studies of serious games or gamification can be funded, but not studies on development of, for example, real-time strategy games. This is like funding car-engine research only where said engines are used to chop wood.

I argue that the research funding agencies (e.g. federal funding such as the EU framework programmes and national funding such as the Swedish Vinnova) need to support research that targets game development in the wild. Access to game companies will be much easier if funding supports research that is directly relevant to the game industry. The unique characteristics of this industry should also be considered when funding applications are reviewed. For example, the innovation, production and sales processes in the game industry are handled very differently from those in the car industry². The norms of the latter should not be used to evaluate the former. Some understanding of the ideas behind the antidisciplinary movement would also be useful.

² For example, the birth of Minecraft differs greatly from that of Volvo.

8.4 Conclusions

This book focuses on research that addresses game development “in the wild”. This book’s studies focus on the development of “regular” games, i.e. those that are popularly perceived as games. Most of these are developed within a “business logic” that invests time and resources in relation to expected player interest. Publicly funded game projects, as is the case in most research, are developed under a very different logic.

One conclusion from the presented material is that there is generally very little research that has studied game development in the wild. The vast majority of game research focuses on the game itself, players, the culture surrounding it or technical details. Research into “serious games” (gamification included therein) dominates. Many such studies seem to assume that the development of regular games is well understood and that it is, in some ways, a “solved problem”. Another conclusion that can be drawn from this book is that game development is definitely not a solved problem. Studios are constantly struggling to create games that attract player interest:

A recurring theme in the interviews was that the informants considered players unpredictable and that they often behave differently than the designers expected, often seemingly irrationally. (Mäntymäki, Hyrynsalmi and Koskenvoima, 2019, p. 8.)

The wicked nature of game development implies that it will never be a solved problem. Yet, it certainly can be better understood.

Another conclusion that can be drawn from said material is that all the presented disciplines have research that is relevant for game development. There are also blank spots in all disciplines, i.e. they lack a perspective that is present in other disciplines. Thus, it is not possible to say, “Game studies has it all, there is no need to look into other areas” or “Information systems research has it all, look no further”. To give some examples, the research in management and game studies does not address challenges related to software design, software testing strategies,

8.4 Conclusions

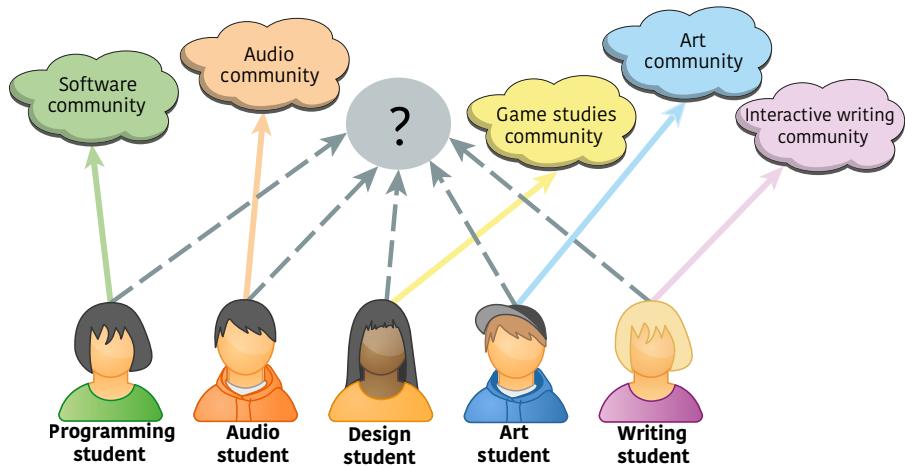


Figure 8.4: There is a missing force in academic structures that gives game students a common focus.

distributed computing, etc. Similarly, studies in software engineering do not address cultural, psychological or societal elements of game production. It is not likely that people from all these academic communities will be able to unite under one single umbrella. The important thing is to encourage tolerance and acceptance for the different perspectives. If a research study aims to contribute to the understanding of game development, it has to consider the complex, bigger picture. Strictly orthodox approaches within a single discipline cannot be *assumed* to be useful outside that specific research context.

Many academic institutions offer game development programmes. These often focus on preparing students for one specific role in game development. This can give deep understanding and knowledge in a specialised field. However, it may not give insight into all other perspectives of game development and how to create a shared meaning. This is something that has to be handled in a game development situation:

In multi-disciplinary, multi-background teams, the issue of shared meaning is far from obvious. On many occasions, we observed the [project manager] arbitrating issues between team-members. Tensions or conflicts usually arise from misunderstandings rooted in different world-views induced by academic and professional backgrounds. (Simon, 2006, p. 120.)

I argue that this tension between worldviews should be addressed early in the academic training of game developers of all sorts. It is an important defining characteristic. Students should not be left to address this on their own. As the number of universities providing game development programmes increases, there is a risk that students will be fostered into a single disciplinary perspective. Many programmes are geared towards an academic career within a specific discipline. Here, introducing course elements that focus on other aspects may be perceived as a distraction. Similarly, interdisciplinarity can meet resistance from faculty boards and deans who may not care very much about games. As a result, students may enter the game development profession with skewed perspectives:

- A software engineer may struggle to get everyone in a team to express a game design as a formal system specification so that the corresponding test cases needed to ensure correct code can be generated.
- A designer may be unaware of how the business model affects a game's dynamics.
- An animator may not understand how user interaction and engine code handle some of the motion in the game³.
- A writer may not be accustomed to balancing artistic ambitions with the vision of other professions (or even not used to giving control to the player).
- A business graduate may not understand why not everyone wants to maximise profit.
- A GUX researcher may not be aware of the differences between scientific methods and play-testing methods.

³ McDaniel (2015) presents an example of this.

8.4 Conclusions

- Everyone may lack experience of collaborating with people who believe in a different research paradigm.

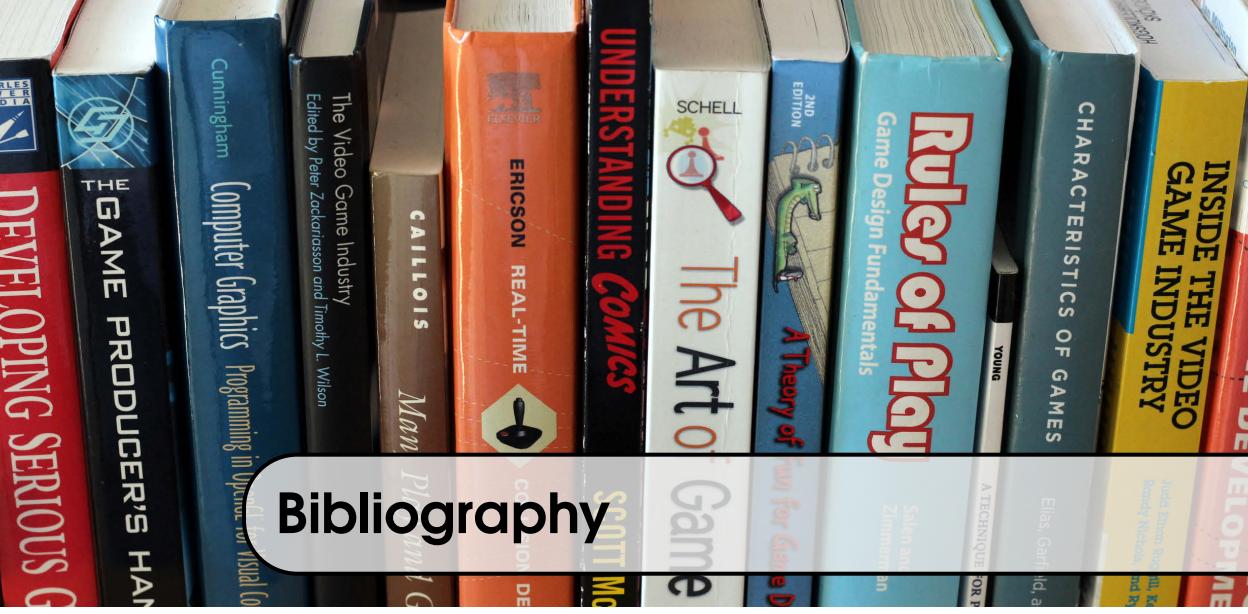
The tension between worldviews is a problem that is hard to solve on a general level. Nonetheless, it can at least be acknowledged in various academic boards involved in game development. To understand game development, some flavour of an antidisciplinary attitude would be, or is, a definite plus. The bottom line is that there needs to be: an understanding of the consequences of a disciplinary focus; and, an acceptance of the importance of other disciplines.

One of the aspects highlighted above is the important role producers have in a game development team. Amongst other things, a producer can act as a bridge between the different disciplines. They can help programmers accept the perspectives of artists and vice versa. In academia, we do not have any producers. Each discipline largely works to its own standards and there are no obvious consequences of ignoring the perspectives of others.

Figure 8.4 illustrates how different game development programmes are geared towards different academic communities⁴. The “luxury” of only understanding one disciplinary perspective goes firmly against students being well prepared for work in game development. There has to be some kind of common ground and openness to the multitude of perspectives in this profession. To achieve this, there has to be something (the question mark in figure 8.4) that pulls students towards a shared meaning. University administrations may need to have someone fulfilling a “producer” role in programmes. This person’s task would be to ensure that faculties involved in educating game students respect the differences between disciplines. If this is not dealt with at a faculty level, it will be left as an exercise for students to handle themselves. This is not fair.

⁴ In this example, the management and business communities are not well represented. This is probably a common situation in many development programmes.

This book is an attempt to present the landscape of game development research. More work is needed.



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Appendix

Notes on the literature searches

The articles highlighted in this book were collected via a number of searches and reviews. This appendix gives an overview of the search processes used in the various stages. A more detailed description can also be found in the following three articles:

- Engström, H. et al. (2018). “Game development from a software and creative product perspective: A quantitative literature review approach”. In: *Entertainment Computing*, 27, pp. 10–22. DOI: 10.1016/j.entcom.2018.02.008.
- Berg Marklund, B. et al. (2019). “What empirically based research tells us about game development”. In: *The Computer Games Journal*, 8 (3-4), pp. 179–198. DOI: 10.1007/s40869-019-00085-1.
- Engström, H. (2019b). “GDC vs. DiGRA: Gaps in game production research”. In: *DiGRA Conference Proceedings*. DiGRA.

Literature search processes

The literature search processes aimed to capture game production research from a broad perspective. Covering game research between 2006 and 2016, searches included studies that approached games from either a software perspective and/or a creative industry perspective. The five-phase search process set out below was devised.

- Phase 1: Organic identification of a reference set of relevant articles. Identification used a large number of keywords in Google Scholar and a forward and backward snowballing process. This initial, organic search found 30 articles that were identified as highly relevant.
- Phase 2: Identification of databases that indexed articles in the reference set. Reliable research databases were queried for each of the articles in the reference set. Databases were added until all articles had been found in at least one database.
- Phase 3: Formulation of search queries that would return all articles in the reference set. The final query was a conjunction of two blocks of disjunctions (see figure A.1).
- Phase 4: The databases were queried to collect a list of potential articles. The results from these searches were combined into a single list of articles in which duplicates were eliminated.
- Phase 5: Based on title and abstract contents, the resulting list was reduced by removing articles that met a set of exclusion criteria. This served to eliminate papers that matched the search query but were clearly unrelated to game development.

Analysing digital game research is challenging. This is because said research involves disparate disciplines with very different traditions and publication forums. Phase 2 resulted in the addition of databases from Scopus, Springer, ACM and DiGRA. The query formulated in phase 3 returned (after duplicate removal in phase 4) 2,278 articles from the four databases. After the title-abstract reduction in phase 5, 488 articles remained. These were then reviewed and coded using a standardised protocol. The protocol included, amongst other things, a rating of research rigour and whether the research presented empirical data from

[videogame OR video game OR video-game OR
 computer game OR game developer OR game development OR
 creative industr OR cultural industr OR visual effect OR
 new media]
AND
[development process OR development project OR
 production practice OR production process OR
 requirements engineering OR software engineering OR
 innovation project OR innovation process OR
 creative process OR business process OR
 professional identity OR idea creation OR
 project management OR management of production OR
 management challenges OR creative production]

Figure A.1: The search query used in the original literature review

industry. An article was classified as having empirical data from industry only if it included some “first-hand contact” (e.g. through interviews, observations, ethnographic studies, etc.) with the game industry.

The following inclusion criteria were used in the study:

- studies targeting the game development process (irrespective of whether the games were conventional, educational or serious);
- studies containing empirical data from the game industry;
- studies focusing on other parts of the creative industry and highlighting creative processes and/or production processes that related to the creative content; and,
- studies highlighting creativity management.

The exclusion criteria used were:

- research published before 2006. This exclusion was mainly based on game development’s “youth” and rapid development (i.e. studies based on the conditions in the 1990s would not be highly relevant);
- research solely reporting conclusions and findings gained from game development projects conducted in a school or university context; and,

- non-English articles. The vast majority of research on games is published in English. Additionally, the reviewers could not easily review in any other major language.

Qualitative analysis of highly relevant articles

From the larger set of 488 articles, the aforementioned method classifications, quality evaluations and case descriptions enabled us to filter out a subset of 48 papers that fulfilled the criteria establishing a foundation for a qualitative review. These articles: contain empirical data from industry practitioners; evidence high-quality of research (in terms of clearly stated research question, method description and results); and, are relevant to understanding practical game development.

Three reviewers subjected the selected papers to a thematic analysis of the papers' content.

This entire process was divided into three distinct phases, namely, a preparation phase, a content processing phase and an analysis phase.

GDC vs. DiGRA

In one particular study presented at *DiGRA Conference* 2019, the data from the preceding reviews was supplemented with data from the last three years (2016 – 2018) of DiGRA conference papers. In total, 125 full papers were searched (title, abstract and method) to determine if they contained industry empirics. This search resulted in the identification of 6 additional papers.

The study compared the focus in research articles with the focus of the *Game Developers Conference* (GDC), presented in section 7.1.

One anonymous reviewer of this DiGRA paper provided a list of 22 highly relevant articles and books that had not been identified in previous searches. The reason for this was either that they did not match the title-abstract-keyword query or that they were published in forums that are not indexed in the databases used.

Expansion of the review in this book

During the writing of this book, the material identified early on was complemented with additional articles that were identified in a less structured way. The primary source of these was the Scopus database. At an early stage, Scopus was queried for articles that, published after 2016, had a title-abstract-keyword match for “game development” but not for terms related to serious games. This returned 676 articles. Based on title and abstract, these were filtered to give a set of 71 articles that were then more carefully reviewed.

In addition to this search, several articles were added through snowballing in the existing material. Kind colleagues also recommended further articles.

A note on the citation of games

In a few places, this book mentions specific games. However, there are no full citations of said games. In studies with a strong focus on specific characteristics of games, it is important to cite the games properly (Gualeni, Fassone and Linderoth, 2019). If a game is analysed, it is highly relevant to present the specific platform used and the version that was played. However, this book does not focus on specific games. Nor were the mentioned games played as part of the research. In most cases, the book's game mentions are linked to the citing of articles. If the reader wants to find more detail about a mentioned game, I recommend consulting the cited article or, perhaps, searching for the game in Wikipedia.



About the Author

Henrik Engström is a professor at the University of Skövde. He holds a PhD in Computer Science from the University of Exeter and has conducted game-related research since 2001. His research focuses on the game development process and, in particular, its entangled, multidisciplinary nature. In a research context, Henrik has served as project manager, producer and developer in a number of game projects.

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Digital games have become a ubiquitous part of our society. In many countries, game development is a substantial and important industry. Academic institutions provide programmes aimed at preparing students for careers in game development. Over the past 20 years, there has been great interest in game research. However, very few studies address game development. Instead, most studies have focused on: serious applications of games; analysis of games and players; or, social aspects of playing.

This book provides an overview of the scattered academic landscape of game development research. It highlights studies from a wide range of disciplines and raises arguments for game development to be understood as a complex activity that inherently includes elements of science, engineering, design and art. The consequences of this complexity need to be taken into account by research and/or academic programmes that have a disciplinary focus. There is otherwise the risk that the true nature of game development will not be understood.

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