

GDC vs. DiGRA: Gaps in Game Production Research

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ABSTRACT

Previous studies have revealed a gap between game research and industry game production. This article presents an analysis of this research gap using the tracks and summits at the Game Developers Conference (GDC) as a point of reference. The result shows that there are several areas where there exists very little research. The DiGRA conference is no exception – since 2006, only a handful of papers present empirics from game production. Studies are in particular rare for content producing areas, such as audio, visual arts, and narrative. There are plenty of opportunities for researchers to extract experiences and knowledge from game professionals and to identify problems to be addressed. To do this, collaboration models need to be established that endure non-disclosure agreements and crunch cultures.

Keywords

game production, game research, literature review, game industry, game developers conference.

INTRODUCTION

In a recent study, Martin (2018) presents an extensive review of research on digital games (1966-2016). Research on games shows an impressive growth in the last 20 years. Martin (2018) shows that there is a great variation in the areas from which games have been studied but also that there is a gap between research and the game industry. The importance of the industry for academia is evident. As an example, the introduction of massive multiplayer online games generated substantial amount of research related to both technological and sociological aspects of this phenomenon. Despite this influence from industry, there are few scholars that have had a focus on the industry itself and the processes involved in creating these artefacts.

It is important to acknowledge that game production, while it shares specific traits with many other types of production, is significantly different than any of its individual parts. The creative process behind a game is a highly collaborative effort where designers, programmers, writers, visual & audio artists, and even testers (Cohendet and Simon 2007; Llerena et al. 2009) contribute. The auteur tradition is not as strong in games as it is in film. Games are rather born from a *creative system* (Bilton and Leary 2002). For games, this system includes the audience. Testing is imperative in game development (Lê et al. 2013; Kasurinen and Smolander 2014; Stacey and Nandhakumar 2008) which makes it different to all other media production (O'Donnell 2011).

From an industry perspective, the Game Developers Conference (GDC) is an important venue for dissemination of experiences and results. This annual conference attracts almost 30,000 professional developers (UBM 2019b) from all over the world

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and many hundreds of presentations are offered in almost 20 different tracks related to game production. Although GDC is a commercial conference, that is part of a profit-generating business (Informa 2019), the format of GDC resembles that of an academic conference. Presenters at GDC are mainly industry professionals sharing results and experiences to other practitioners.

This article presents a literature review with a goal to analyse the gap between game production and research in more detail. We refer to research that includes *empirics* from the digital game industry as *game production research*. We adopt a very inclusive definition of game research and include studies from a wide range of venues and traditions. The selected studies are classified using a scheme based on the tracks and summits provided at GDC. The gaps are identified with respect to this proposed scheme under the assumption that it represents an industry perspective of game development. Studies presented at the DiGRA conference are highlighted in this analysis.

The result shows that there are several areas of game production where there is almost no research with industry empirics. This includes central areas such as audio, game narrative and visual arts. In some of these, there have been a strong academic interest (e.g. game narratives) but this has not included empirics from industry production. In other areas, such as game production & team management there has been a fair amount of research – but mainly from a technical perspective. The conclusion from this study is that there is a need for studies of game production in many different areas and from different perspectives. There is a general need to intensify the connections between academia and industry, but to do this we need to find new forms of collaboration and to address obstacles such as non-disclosure agreements, industry cultures and the lack of research funding.

BACKGROUND

Game Developers Conference

The GDC is an industry-oriented conference founded 1988 by Chris Crawford, who also authored one of the very first books on game design (Crawford 1984). Since then, GDC has grown to be the dominating venue for the computer game industry. This annual conference has a large number of attendees from the game industry and the program has almost 20 different tracks with over 700 sessions. The presenters at GDC are mainly professional game developers representing successful game companies. The format can be seen to support a community of practice (Lave and Wenger 1991) among game developers. The conference resembles an academic conference in that speakers submit proposals that are reviewed by an advisory board composed of mainly industry experts. The reviewing is not 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 interests that potentially can give conflict of interests.

The focus in GDC is on attendees' "takeaways". The presentations are focused on sharing of experiences and presenting novel solutions. In addition to the conference presentations, GDC also has a strong focus on business-oriented activities such as an expo and sponsored events. The core of the GDC conference is the main tracks scheduled during the last three days. It is preceded by two days of summits and tutorials. There is also a game career program targeted at students. Finally, the Virtual Reality Developers Conference (VRDC) has been co-located with GDC the last three years.

A GDC track or summit presentation is not accompanied with an article or paper. The slides and the recorded presentation are instead made accessible in the *GDC Vault* (UBM 2019a). Some of these presentations are made freely available but a membership is required for full access. There are both individual (\$550 per year) and studio memberships and this indicates that the material is found valuable to the industry. The interest for GDC from the academic world is however modest. Scopus returns 152 articles that reference material from GDC Vault. A title-abstract-keyword search for “Game Developers Conference” in Scopus yields 9 hits. These are mostly technical (e.g. *SIGGRAPH* and *Dr. Dobb’s Journal*) but a notable exception is the frequently cited article by Hunicke, LeBlanc, and Zubek (2004) on the MDA framework which they developed at GDC Workshops. The focus on academic research in GDC is limited – the UX Summit is an exception when 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* with the exception of four design panels (2006, 2007, 2008, and 2010) with Ian Bogost, Mia Consalvo, Jane McGonigal and Michael Mateas (only 2010).

The GDC has a clear North American/UK Industry perspective. The conference is stationed in San Francisco and the language is English, exclusively. There are GDC events in other continents but at a smaller scale. GDC is organized by *UBM*, which is a part of *Informa* – a multi-national business intelligence, publishing and event corporation. In this context it can be worth noting that the academic publishing division of Informa is operating as the Taylor & Francis Group – one of the major players in academic publishing. In addition to organizing GDC, UBM is also in charge of *Gamasutra*, which is another leading game industry communication channel. It is clear that Informa has a leading role as a provider of game production information.

Game Research

Martin (2018) conducted an extensive, quantitative literature review based on game research indexed in the Scopus database. Studies from 1966 to 2016 are included in his study. Research on digital games has had an almost linear increase since the end of the 90s when it started to grow. More than 3000 articles from 2015 were included in the review. There are a significant number of venues that have an explicit focus on game research. Of these, *Simulation & Gaming*, *Game Studies* and *DiGRA Conference* are dominating in terms of published articles (Martin, 2018). Melcer et al. (2015) conducted a co-word and co-venue analysis of articles published between 2000 and 2014. This study selected the 21 core game research journals and 27 core game research conferences. They present 20 major themes in game research. Some of the bigger themes are game design, serious games, interactive storytelling, virtual reality, and user experience. Melcer et al. (2015) identify a clear gap between technical and non-technical research. They state that the *FDG* and *DiGRA* conferences play a role as a bridge between these communities.

DiGRA was founded 2003 and the first conference was arranged the same year. The conference was first biannual, but since 2014 it is an annual event. *DiGRA* targets “academics and professionals who research digital games and associated phenomena” (*DiGRA* 2019). Game professionals are in the target group of the conference and the call for papers have included topics such as “Games business”, “Game production studies”, “Game technology” and “Technological systems”. The *DiGRA* conference appears as a good target for all types of game production research. Melcer et al. (2015, 7) state “*FDG* tends to have a stronger technical focus while *DiGRA* is more broad”. The technological dimensions of digital games are however mainly disseminated in other forums (Quandt et al. 2015). The *SIGGRAPH* community, for example, has long traditions on game-related research. In Scopus, 1500 articles match

a title-abstract-keyword search for “game” at a SIGGRAPH conference. The first such article is from 1978 and addresses real-time animations for games (DeFanti et al. 1978). The SIGGRAPH community expressed an early interest for collaborations with GDC (Rhyne 2000). It is interesting to note that Melcer et al. (2015, 2) exclude SIGGRAPH and similar venues from their study “since their primary focus is not games research itself and the core games research venues primarily cover the same topics”. This may be true, but the exclusion of SIGGRAPH and similar venues exclude a large fraction of the technically oriented research (Quandt et al. 2015).

Although there is a general interest in computer game research there is a notable lack of game production research, i.e. research that includes empirics from the game industry. Martin (2018) highlights this fact in his study. The same observation is made in Engström et al. (2018) where a broad literature review is presented that focuses on the duality of digital games as being both software and creative product. The result reveals that the existing studies of game production are mainly from a computer science or management perspective. Very few studies approach game production from a humanities or social science perspective. Studies that approach games from a technological perspective frequently acknowledge games to be different from traditional software but rarely they acknowledge the fundamental differences between art and engineering. The existence of such a difference was, for example, shown by Hodgson and Briand (2013). They analysed the use of agile production methods in a Canadian AAA studio. The interviews revealed that the producers had to introduce exceptions for the artists who hated the agile methodology. Studies such as this shows that there is a need for a dual perspective on game production.

PROBLEM

Game production and game research has co-existed for many years. As shown by Martin (2018), there is a lack of research studies focusing on the solutions and problems in the game industry. This perspective is on the other hand the main focus at the GDC. Experiences from successful commercial game development are disseminated in a manner that resembles that of an academic community. There are however some fundamental differences that motivate academic studies of industry game production. First of all, GDC does not have any obligation to follow research principles such as objectiveness, openness or to honour ethical guidelines. Secondly, GDC is very focused on a utilitarian perspective and audience take-away. This nourishes certain type of approaches and presenters¹. Moreover, a presenter at GDC is mostly reporting results from a single project, company or their own personal experiences. Being a company representative restricts how much a presenter can reveal and how freely they can highlight problems and challenges. The revenue demands from the owners behind GDC may also gear focus towards industry interests rather than interests of employees when there is a conflict. There is a need for independent studies that include many cases in order to find commonalities and trends. Research can collect and present these results while keeping the companies and informants anonymous. Problems and challenges can be highlighted by research in a way that is not possible at GDC. An understanding of game production is also needed for our educational programs to prepare students for a career in industry. Direct collaboration between industry and research is well established in many production areas in engineering (e.g. see Balconi and Laboranti 2006). One example of this is the concept of industrial PhD students (Kihlander et al. 2011). It has been shown that such programmes contribute to both industry and academia.

Taken together, there is a need for more studies on game production and a better alignment between research and industry perspectives.

This article aims to explore the gap between research and industry in more detail by reviewing the existing industry research from the perspective of the game industry. The gap is studied on two levels: game research in a very broad sense, and the subset of research that has been published at the DiGRA conference.

The contribution of this study is twofold. Firstly, existing game production research is identified, analysed and presented. Secondly, the gaps in this research from the perspective of the GDC are highlighted.

This article is only concerned with studies that include empirics from industrial game production. It is outside the scope of this article to evaluate to what extent theoretical studies, or studies of non-industry production (art installations, university projects etc.) have found their way to the industry. The focus is on research that studies game industry production.

METHOD

The approach taken in this article is to use the tracks and summits at GDC as a starting point and then map the existing research on these. This will reveal areas that are highlighted by industry but that have received little interest from the research community. The method used is a systematic literature review (Okoli and Schabram 2010) that follows these major steps:

1. Selection of literature.
2. Creation of a coding scheme based on the GDC tracks and summits.
3. Coding of the selected literature using the scheme.
4. Synthesis of studies to identify themes in the research within each of the codes of the scheme.
5. Identification of gaps in research with respect to the scheme.

Step 1 in this study is mainly based on material that was extracted and coded in an extensive literature review covering game research between 2006-2016. This review's aim was to capture game production research from a broad perspective. This included studies that approached games from a software perspective as well as those from a creative industry perspective. A five-phase search process was devised (details can be found in Engström et al. 2018):

- Phase 1. Organic identification of a *reference set* of relevant articles using a large number of keywords in Google Scholar and a forward- and backward snowballing process. From this initial organic search, 30 articles were found that were identified as highly relevant.
- Phase 2. Identification of databases that index articles in the reference set. Reliable research databases were queried for each of the articles in the reference set, and 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. The first disjunction (10 terms) was variations of “video game”, “creative industry”, and “new media” and the second disjunction (16 terms)

contained synonyms for “development process” (e.g., production process, innovation process, creative production etc.).

- 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 where duplicates were eliminated.
- Phase 5. The resulting list was reduced, based on title and abstract, by removing articles that met a set of exclusion criteria. Exclusion was based on title and abstract contents, and served to eliminate papers that matched the search query but were clearly unrelated to game development.

As pointed out by Martin (2018), it is challenging to analyse the computer game research as it involves many disparate fields with very different traditions and publication venues. Martin's study is based solely on the Scopus database. Phase 2 resulted in the addition of databases from Springer, ACM, and DiGRA². It was apparent that Scopus was not sufficient. In the final set of papers studied in this article, 70% are indexed in Scopus. It is likely that additional articles would have been found if more databases had been included. Another factor that affects the result is the search process and formulation of search query (phase 3). In the presented study, articles were selected based on a title-abstract-keyword search. After duplicates had been removed, the query returned 2,278 articles from the four databases. After the title-abstract reduction in phase 5, 488 articles remained that were reviewed and coded using a standardised protocol. The protocol, by other things, included a rating of research rigor and whether the research presented industry empirics. An article was classified to have empirics from industry only if it includes some first-hand contact (e.g. through interviews, observations, ethnographic studies) with the computer game industry. Studies that analyse games, players, or study university projects are not classified to have industry empirics.

For the study presented in this article, the data from Engström et al. (2018) has been used to select papers with research rigor that include empirics from the industry. The selection gave 54 such papers.

The selection of papers from the extensive review has been complemented with the last three years (2016-2018) DiGRA conference papers. In total 125 full papers were scanned (title, abstract and method) to determine if they contained industry empirics. This resulted in 6 papers that were found to have industry empirics and were added to the review. This means that in total 60 papers are included in the review presented in this article.

The analysis of selected papers is based on the track and summits provided at the GDC. The assumption is that these tracks represent the most relevant areas from an industry perspective. A hierarchy has been proposed and used to code the selected articles. This allows for an identification of the gaps between the industry perspective and research.

The coding and analysis was conducted using the qualitative analysis software *MAXQDA* (Verbi 2018).

RESULTS

The GDC Perspective

GDC offers a very wide range of activities during a week each year. The analysis presented in this article has been focused on the tracks (Table 1) and summits (Table 2) provided at GDC'19. The tracks and summits constitute the core of the conference and is the main arena for communication of experiences and results. The VRDC is not included in the analysis as it is strictly speaking not a part of GDC.

The first five tracks in Table 1, together with *audio*, represent areas that are commonly discussed in game development, and that are closely connected professional identities. *Advocacy* is slightly different as these topics have implications in many tracks. For example diversity is highly relevant to discuss in relation to design, visual arts and management. The *vision* and *classic game postmortem* tracks are excluded from the analysis. They do not address any particular production activity but are explicitly inspirational and reflective – looking into the future and at the past. They are also small in terms of number of presentations.

The summits are more diversified than the main tracks. The *UX*, *narrative*, and *community management* summits represent developer roles comparable to those in the main tracks.

Table 1: GDC Main Tracks 2019. Keywords have been extracted from the track descriptions.

Track name	Keywords from track description	# of events ³
Programming	Skills; techniques; platforms; high production value; tools; middleware; technical skills	196
Design	Methods; interaction; tools; systems; techniques; ideas	126
Visual Arts	Leading artists; art styles; concepts; inspiration; process; methods; art and animations; from concept art techniques to post-production; best practices	97
Game Business & Marketing	Industry trends; business opportunities; network; partnerships; marketing; user acquisition; community building; coverage from press; streamers; influencers.	95
Production and Team Management	Tactics for managing game production; keep teams and projects on track; increase efficiency; ship games on time.	65
Advocacy	Diversity; censorship; quality of life; social advocacy; discussion; effect change for the development community.	62
Audio	Knowledge; experience; real-world; aesthetic, technical, business, and logistical problems.	60
Vision	Future of the game industry; Game innovation; Ideas.	6
Classic Game Postmortem	Behind the scenes; lessons learned; inspiration	5

Table 2: GDC Summits 2019. Keywords have been extracted from the summit descriptions.

Summit name	Keywords from summit description	# of events
Independent Games	Indie game creators; lectures; postmortems; diverse voices; experiences; perspectives; Independent Games Festival	32
Narrative	Interactive narrative; AAA blockbusters; indie games; mobile; social projects; advanced theory; practical case studies; writers; designers; producers; interactive storytelling.	19
Mobile	Game design; business strategies; iOS; Android; Amazon; developers; share ideas; best practices; free to play.	17
AI	Architectures; conversations; debates; move forward; intermediate to advanced programmers	16
Educator	Ideas; best practices; approaches; game development programs; new game course creators; professional development; explore challenges	16
UX	Design; best practices; quality; engagement; business intent; experience; target audience; cognitive science; psychology; research findings.	9
Community Management	Inspire; user loyalty; enthusiasm; community opinion and adoption; case studies; postmortems; strategies; tips; community's needs; company's goals.	8

The *educator* summit is targeted at educators rather than developers and is hence excluded from this analysis⁴. The *AI* summit can be seen as a focus area under programming. This is apparent from the description that states that it “is targeted to intermediate to advanced programmers”. Other perspectives on AI (e.g. design, narrative and testing) that could have been in focus are not highlighted. In this analysis, AI is seen as a part of programming. The final two summits, *independent games* and *mobile*, represent distinct market segments that have implications crosswise the development, similar to advocacy.

A proposed classification of GDC's perspective is shown in Figure 1. This has been used to code the literature.

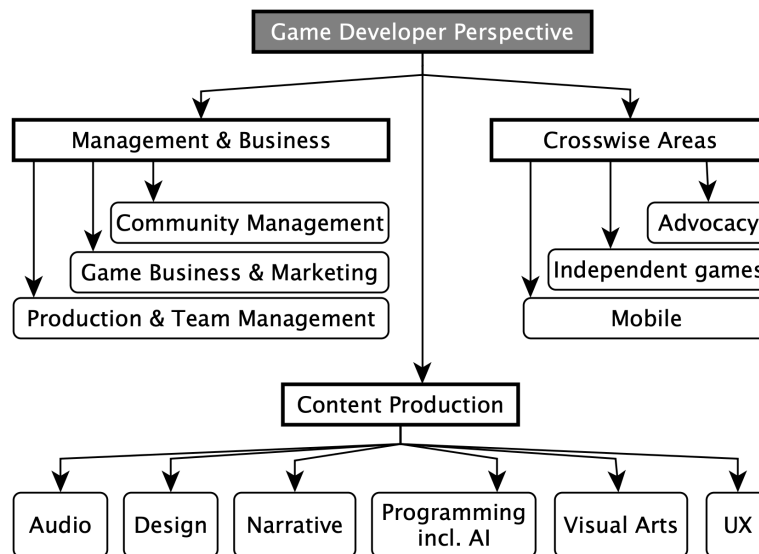


Figure 1: A proposed classification of the game developer perspective, based on the GDC 2019 content.

The codes are organized in three proposed main categories: content production, management & business, and crosswise areas. Each leaf node corresponds to a track or a summit, with the exception of programming and AI that have been combined.

Game Production Research

The coding and analysis of 60 articles with game industry empirics revealed some strong themes within the categories of the classification. This section presents each category and themes that has been studied by research. This forms a basis for identifying the gaps in the following section.

Content Production

Design is the production sub-category best represented in the studied material. The research is focused on the ideation process (Hagen 2009; Kultima 2010; Tschang and Szczypula 2006) but there are also examples of studies of design tools (Nelson and Mateas 2009) and the role of technology in the creative process (Lê et al. 2013). Designers are also well represented as informants in many interview studies. This is motivated by the designer's central role in game development.

The technical perspective on game development is also well represented in the material but mainly from a management perspective. There is a large gap in terms of the *content production* perspective on programming. A few exceptions from these exist in the studied material. Murphy-Hill et al. (2014) present an extensive comparison between traditional software industry and game industry with respect to the programmer's role. The study highlights several fundamental differences and is an excellent example of the need for studies specifically targeted at the game industry.

In UX, there are several articles (Canossa et al. 2016; Drachen 2015; Drachen et al. 2013; Hullett et al. 2012; McAllister and White 2015) focused on game user research and game analytics. Interaction design and interface design are briefly mentioned in a few studies (Kasurinen, Strandén, et al. 2013; Bryant et al. 2010).

Visual arts are acknowledged as a central element in most studies but the specifics of the craft are only briefly discussed in a few studies (Stacey, Brown, and Nandhakumar 2007; Hodgson and Briand 2013; Hicks et al. 2018). O'Donnell (2011) is an interesting example as he highlights how visual art is different in game productions compared to movie visual effects. The findings in this article resembles that of Murphy-Hill et al. (2014) although they approach game industry from two different perspectives.

For the remaining content production areas, audio and narrative, there is a startling lack of studies. One article (O'Donnell 2011) highlight some elements regarding the audio production process (the recruitment of voice artists) and another discuss the storage requirement for dialog audio on the DS console (Bryant et al. 2010). Game narrative is listed among game components in many articles. Very few mention (Ruggiero and Watson 2014; O'Donnell 2011) the mechanics-story tension, but none goes into any details.

Management & Business

The majority of studies approach game development from a management perspective. This is mainly software engineering studies, which mostly analyse how methods from this field can be applied to game development (Kasurinen, Laine, et al. 2013; Kasurinen et al. 2014; Koutonen and Leppänen 2013; Schmalz et al. 2014). There are also many studies that approach the field from a business and management perspective (Cohendet and Simon 2007; Hodgson and Briand 2013; Simon 2006). One good example is Zackariasson et al. (2006) who present a rich description of the

management of creativity in a medium sized PC game company. Another area represented in research is studies of gameworkers (Stacey et al. 2013; Wimmer and Sitnikova 2011).

The business and marketing dimension of the game development is represented in a handful of studies (Aleem et al. 2016; Consalvo and Paul 2017; Kasurinen et al. 2014; Vanhala and Kasurinen 2014). The role of the publisher is discussed in several cases (Chung and Fung 2013; McAllister and White 2015; Walfisz et al. 2006) and early articles discuss their role for funding, planning and managing of projects. Schmalz, Finn, and Taylor (2014) point out that the role of the publisher may be diminishing. An implication of this is that self-publishing game developers need to handle many of the publisher responsibilities (Aleem et al. 2016) (e.g. business models, marketing channels, target etc.). How this is addressed by indie game developers is presented in some recent studies (Consalvo and Paul 2017; Toftedahl et al. 2018).

Community management is not well studied in research. A few articles touch upon the subject (Arakji and Lang 2007; Lee et al. 2006; Llerena et al. 2009) but none studies how community management is organised and handled in the industry.

Crosswise Areas

The mobile and independent game sectors are well represented in the material. Several studies include independent game developers in their empirics but few have an explicit focus on the indie perspective. This is different from mobile games on which several studies have an explicit focus (Alves et al. 2007; Bhowmik et al. 2014; Stacey et al. 2007).

The advocacy dimension is not strongly represented in the material. One example is Legault and Ouellet (2012) who interviewed 53 game professionals⁵ on how overtime is handled in industry. The result reveals a situation where overtime is both unlimited and unpaid.

The DiGRA Perspective

In the studied material, 8 papers have been published at a DiGRA conference. Although the sample of DiGRA papers is very small (indicating a general gap) it is interesting to analyse what type of industry empirics that they contain.

Several papers have industry empirics that are either unclear, do not focus on the industrial activities or are collected without having direct contact with industry representatives. Two studies report experiences from workshop and/or gamejams that include participants with professional game developer experience (Parker and Galloway 2016; de Salas et al. 2016). Another case (Consalvo and Paul 2017) is based on analyses of the *subreddit r/gamedev* forum and developers blogs at Gamasutra. Canossa et al. (2016) assess an analytics tool they have developed. This is done through industry expert evaluation. One paper (Hicks et al. 2018) analyses the perception of the concept *juicy design* through a questionnaire targeted at game developers.

Only three papers collect empirics through direct contact with developers in order to study their ordinary work processes. All of them do this through interviews. The research questions of these studies are related to game ideation (Hagen 2009), the professional identity of gameworkers (Wimmer and Sitnikova 2011), and game localization (Toftedahl et al. 2018).

Gaps in Game Production Research

The presented study includes material from a very wide selection of publication channels and disciplines. In comparison to the initial set of papers (>2000), the resulting set of game production research papers was small (60). This reflects the general gap pointed out by Martin (2018). This section highlights and discusses the gaps with respect to the GDC categories.

Content Production

Very few studies focus on the specifics of any particular profession and its role in game production. Game design has been studied to some extent but the other disciplines are more or less white areas on the map. For all individual professions, the game production is highly interconnected with other professions. How this collaboration is organized and how it affects the craft of each discipline is something that needs further study. Each area has specifics that unfold once they are studied. Below, some potential elements of study in the least studied fields are identified.

There is almost no research that addresses audio elements in games. The importance of audio for the emotional experience is well known. The size of the audio track at GDC is an indication of its importance in the industry. Research with empirics from game audio production is almost totally absent. This may be the most remarkable gap between the GDC and research. Areas that could be studied include: tools and processes used to create interactive music and ambience in games; the role of audio in UX; and the role of audio in game design. Logistical problems are highlighted in the GDC description of the audio track. One possible candidate for studies with respect to this is the voice acting processes and management of non-linear scripts.

The visual characteristics of games have been given much attention in recent decades. The technical development have been revolutionary and have constantly moved the barriers of what is possible to represent with real time graphics. The research community has been highly involved in this revolution but mainly from a very technical perspective. The non-technical dimension of computer game graphics is far less studied. There is a notable gap in the research on how game artist approach their craft and how the interplay between artistic expression and technical systems are handled in studios. The modelling and animations in games are different from, e.g., movie production (O'Donnell 2011). Another challenge addressed briefly in one study (Hodgson and Briand 2013) is how to achieve a unified artistic expression in the team of artists. Visual arts share many of these challenges with audio. The description of the visual arts track at GDC highlights process and method so this is apparently of interest to the industry.

Interactive narratives and narratives in games have received a massive interest from the research community. The industry has also produced many titles the last decades that have received a lot of attention for their narratives. There are however almost no empirical studies of writing in game productions. This gap is remarkable. Researchers should study how the industry is managing this process. This could, for example, be to study how game writers and narrative designers work with interactive narratives in collaboration with other professions. It could be to study of the processes and tools used to model and create the narrative. As an example, a panel of AAA game writers report that the biggest challenge for game writers is the absence of a universal tool or format (Francis 2015). How game narrative professionals recruit, direct and record voice actors to work with non-linear dialog are other areas for studies.

The UX perspective is well represented in research, in particular in relation to the size of the UX summit at GDC. Research has mainly focused on game user research and

less on the production side of UX. The role of UX and its relation to game design, in industry game projects, is a gap for future studies.

The programmer perspective is well represented in the studied material in many ways. Still there exists gaps as most technical research is not concerned with the game production context and hence do not include empirical studies. This is for example the case with most computer graphics, network, and AI research. The main bulk of computer science research that involves empirics from industry is focused on management aspects. There are some exceptions to this – the most notable being Murphy-Hill et al. (2014) that highlight how the nature and culture of game development gives differences in how programmers work with, for example, code design and testing. More studies of this could be conducted. Another research gap for programming is the collaboration with other disciplines. Technical art is one example. Another is game AI that can have very close connections to design and narration. Considering the interest for programming and AI at the GDC, there is definitively room for more technically oriented studies that are focused on the complex environment that game studios constitute.

The role of tools is a theme for all disciplines discussed in this section. The development of design tools (as well as tools for other professions) is a common task for programmers but it is not commonly addressed in research. Tools have been studied in a few cases (Kasurinen, Strandén, et al. 2013) but more work can definitively be done. The interplay between technology and ideas is very well exemplified in the study by Lê et al. (2013). Tools have a central role in the development of mankind, but they also impact on the creative process of game development. Maslow's hammer applies also in this context: if all you have is a hammer, everything looks like a nail.

Management & Business

The management dimension of game development is relatively well covered in the studied material. The gap here is more in terms of the perspective on management. There is a bias towards methods from software engineering, and on the processes for game design. Studies of management of other processes, such as that associated with game writing, audio and visual arts mentioned above, have not been reported.

In several technically centred articles (Hodgson and Briand 2013; Murphy-Hill et al. 2014; Stacey et al. 2007), artists are described as problematic when they do not conform to a (technically oriented) process. At the same time, game programmers are frustrated with the lack of technical understanding from management (Murphy-Hill et al. 2014). There are fundamental differences between the different activities and processes involved in game development. Successful game producers handle these differences but it is not well understood *how* they do it. More research with a dual perspective on management is needed.

As pointed out by Martin (2018), there is a lack of attention to the game business in game research. This was also apparent in the studied articles. The economical dimension of games is mostly addressed in terms of costs – e.g. that audio and video assets are costly. Other aspects, such as how business models impact on design need further studies.

Crosswise Areas

Mobile games and independent game developers are well represented in the studied material. The *advocacy* category is very wide and there are many aspects that lack research. One example of such a gap is the area of diversity (e.g. gender, disability, and sexuality) – both among employees and in the games. Surprisingly few studies

that address these topics, from an industry perspective, were found in the material. Related to this are studies of game accessibility, which is not present in the studied material.

The DiGRA Perspective

Game production research is rare at the DiGRA conference. Without doubt, there is plenty of room for more such studies. The DiGRA community may not have a strong technical focus⁶ but the development process involves many other perspectives. If the study of game production is left for software engineers or management scholars there is an apparent risk that important elements will be missed. The production of visual art, audio and narrative and its relation to artistic expression and the game experience is not well understood in the technical communities.

Limitations

The presented literature review is focused on research that includes first-hand empirics from game production. There exist many other research approaches that can contribute to the understanding of the game industry. This includes consumption-side analyses; studies of modding and interactions between consumers and producers; economical analyses; and studies of the produced games. The focus on first-hand empirics is made to limit the scope of the study. It should be noted that the selected research constitutes a very important subset of all game industry research in that it is precisely *first hand*. A limitation with the presented work is that it only covers studies conducted 2006-2018. Studies before 2006 however constitutes a small fraction of the total research (Martin 2018) and the changes in industry make them less likely to be relevant.

During the process of preparing this article, relevant material was found that would have matched the scope of the review⁷ but where the abstract and keywords did not use the exact terms used in the query. This occurred in spite of an ambitious process to create the query.

The selection of articles from the DiGRA conference 2016-2018 was made differently from the other articles. Fewer articles would have been selected from the search query. The inclusion made it possible to analyse the DiGRA research in more detail. Several of the presented articles would not have qualified to have clear empirics from the industry if the protocol from Engström et al. (2018) had been used.

It should be noted that the tracks and summits of GDC have varied over the years. The main topics included in the proposed classification have been represented at GDC for many years (Rhyne 2000).

DISCUSSION AND CONCLUSIONS

The lack of game production research has been reported in several previous studies (Martin 2018; Deterding 2017; Engström et al. 2018). In this article, the gap between industry and academia is analysed in more detail. The starting point is the tracks and summits provided at the GDC – the largest game industry venue in the world. The result of the analysis shows that the biggest gap is with respect to content production activities. The management perspective is relatively well represented in the studied material but mainly from a technical perspective.

To be able to conduct industry-oriented research, researchers need to get 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) that creates an environment where *any* additional tasks can be perceived as problematic. Another challenge for research is the non-disclosure agreements culture that is strong in many

companies and which makes it hard to collect and disseminate empirics (Linderoth 2015). The indie game companies may be more open (Consalvo and Paul 2017) but they may also have differences in scale and maturity. New forms of collaboration between industry and academia need to be established. An additional challenge for industry-oriented research is the type of research funding available. 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 are almost exclusively focused on areas outside the core industry. Development of serious games or gamification can be funded, but not studies on development of, for example, real time strategy games. This is as if research on car engines would be funded only if it studied how engines can be used to chop wood.

Most research on digital games has been conducted outside the game industry. This can be beneficial as it makes research independent of commercial interest and fixed organizational structures. There are however good reasons to study the operations of the game industry. Studies of (successful) game companies are important to capture their knowledge but also to identify relevant problems and challenges where research is needed. Otherwise there is a risk that research will be too detached, leading to a self-contained eco-system based on over-simplified assumptions. As apparent from GDC, the industry includes a very broad set of areas from technical to artistically, from management, production and business to advocacy. In academia there is a clear separation in terms of the different involved disciplines (Melcer et al. 2015; Deterding 2017). The technically oriented venues lack an art/humanities perspective on games while the non-technical venues many times lacks an understanding of the devils in the technical details. Several studies from industry report on the importance of the interplay between perspectives (Lê et al. 2013; Stacey and Nandhakumar 2008) in the generation of new ideas and for the production. The disciplines involved in development appear to be more tightly connected in industry than is the case in the academic community. The dichotomy between technology and art/humanities is problematic for studies of game production. Digital games are born from the marriage between technology and art; between rules and play; between sense and sensibility. Both perspectives are needed to understand this process.

The study presented in this article can be seen as an attempt to schedule the past game production research to be presented at a GDC conference. The result shows that here are some tracks and summits that would be really sparse on contents. The audio track would be sadly silent. There would be little to see at the visual arts track, and nothing to tell at the narrative summit.

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ENDNOTES

¹ As stated by a user at the [gamedev.net](https://www.gamedev.net/forums/topic/654967-should-i-subscribe-to-gdc-vault/) forum in response to a question regarding GDC Vault: “It’s like watching Netflix, but full of game industry contents.” (<https://www.gamedev.net/forums/topic/654967-should-i-subscribe-to-gdc-vault/>, accessed 2019-02-11)

² The DiGRA conference is partly indexed in Scopus. Full papers at the main conference 2005-2015 are present (accessed 2019-02-10).

³ The data has been extracted from <https://schedule.gdconf.com> (accessed 2019-03-19). For the events in the main tracks, 26% are sponsored and 16% cover two topics.

⁴ The educator summit constitutes an important bridge between academia and industry, but it represents an activity targeted at academia rather than at industry and is hence excluded in this analysis.

⁵ All developers are referred to as *video game designers* in this study. The group however had representation from all production areas, except UX and narrative.

⁶ The paper by Canossa et al. (2016) is the only studied DiGRA paper with a clear technical perspective.

⁷ One example of this is Linderoth (2015) who presents empirics from the industry related to narratives in games. The title-abstract-keywords in this article did however not match the search query used in this study.

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