Knowledge bases, innovativeness and competitiveness in creative industries: the case of Hamburg’s video game developers

Oliver Plum and Robert Hassink*

University of Kiel, Geography, Kiel, Germany

(Received 8 April 2014; accepted 17 September 2014)

Due to its growing economic power, creative industries have climbed scholars’ and policy-makers’ agendas in recent years. However, in comparison with a high number of cluster studies on rather traditional industries, systematic research on knowledge production, innovation processes and competitiveness in creative industry clusters is still underrepresented. This paper aims to fill this gap by investigating the video game development industry in Hamburg, Germany, from a knowledge base perspective. The paper concludes that both the symbolic and the synthetic knowledge are the dominant elements that contribute to video game development in Hamburg. On a more critical note, it doubts whether the currently discussed knowledge base perspective is sufficient to explain the competitiveness of creative industries and proposes to analyse procedural knowledge in future research in order to be able to do so.

Keywords: knowledge bases; knowledge sourcing; innovation process; network analysis; video game industry; Hamburg, Germany

Introduction

The global video game market has rapidly changed from a niche into a mass market serving various gaming platforms (computer, consoles, handheld devices), all underling permanent technological improvements. In fact, today’s video game industry is far from being an economic lightweight in comparison with other creative industries, with global revenues rivalling those of film-making or music publishing (Cadin & Guérin, 2006; Dyer-Witheford & Sharman, 2005). Further examples of the multifaceted spectrum of creative industries include literature, advertising, fashion or performing arts. These industries have in common that, at their very core, they encompass non-material and symbol-intensive goods and services mixing commercial and cultural interests at the same time (Caves, 2000; De Propris, Chapain, Cooke, MacNeill, & Mateos-Garcia, 2009).

Tschang & Vang (2008, p. 2) rightly state that the ‘perceived importance of the creative industries has triggered extensive research in economic geography and the spatial organization of creative industries’ (e.g. Aage & Belussi, 2008; Berg & Hassink, 2014; De Propris et al., 2009; Florida, 2002; Grabher & Ibert, 2006; Lazzaretti, Boix, & Capone, 2008; Nachum & Keeble, 2003; Rantisi, 2002; Romein & Trip, 2010; Scott, 1997; Sedita, 2008; Staber, 2008). However, there is still a lack of systematic empirical research in knowledge sourcing and knowledge networking of actors producing cultural goods. This is somewhat surprising since knowledge, innovation, network or creative
industry are omnipresent buzzwords in current debates within regional development contexts or industry-specific case studies. The shortcoming applies even more to the digital play sector, though a few exceptions can be found in economic geography literature dealing with this industry (Cohendet & Simon, 2007; Izushi & Aoyama, 2006; Johns, 2006; Lange & von Streit, 2013; Oh, 2007; Storz, 2008; Tschang & Vang, 2008; Venkatraman & Lee, 2004).

This paper contributes to this body of literature by analysing the economic geography of knowledge sourcing and knowledge networking of Hamburg’s video game developers from a knowledge base perspective, differentiating between the symbolic (creativity-based), synthetic (engineering-based) and analytical (science-based) knowledge base (Asheim & Coenen, 2005; Asheim & Gertler, 2005). Due to its diversified approach, the knowledge base concept is potentially useful to systematically unravel the complex and manifold nature of knowledge processes and its effects on the firms’ patterns of knowledge sourcing and inter-organizational learning within and beyond the video game cluster’s boundary (e.g. Martin & Moodysson, 2011). It implicitly also tries to explain differences in competitiveness as Asheim, Boschma, & Cooke (2011, p. 897) made clear: ‘‘The knowledge bases contain […] strategies of turning knowledge into innovation to promote competitiveness.’’ In addition to the knowledge base potential, the alternative procedural knowledge is discussed in this paper, which recently has been put forward as an important element in explaining competitiveness of creative industries (Cacciatore, Tamoschus, & Grabher, 2011). This paper therefore has two aims. First, to analyse which knowledge base drives Hamburg’s video game development cluster. Second, to assess the analytical power of knowledge bases for examining knowledge characteristics, innovativeness and competitiveness of creative industries and to discuss potential additional alternatives. It argues that the knowledge base concept has its merits in analysing and explaining knowledge characteristics and innovation pattern of creative industries, but that it is much less powerful at analysing and explaining the competitiveness of creative industries than procedural knowledge. Although there is a broader literature on creative industries (for reviews, see Boggs, 2009; and Berg & Hassink, 2014), it is not the aim of this paper to delve into and contribute to that literature. The paper is written in the framework of a research project sponsored by the European Science Foundation in which knowledge bases were the main theoretical basis. Since the research design was geared towards analysing knowledge bases in different kinds of clusters, this paper will not go far beyond the scope of knowledge bases in relation to creative industries.

The paper is structured as follows. The second section introduces the knowledge base approach as a theoretical framework for the interpretation of the empirical results presented in the third and fourth sections. In the fifth section the key findings are presented, as well as an outlook for future research.

Setting the frame: knowledge bases and creative industries

The knowledge base approach, which was introduced by Laestadius (1998) and Asheim and Gertler (2005), provides a promising framework that helps to reveal crucial differences in knowledge formation and related innovation processes and competitiveness between various industries. The authors distinguish the analytical (science-based) from the synthetic (engineering-based) and the symbolic (creativity-based) knowledge base, each implying particular combinations of tacit and codified knowledge (Nonaka & Takeuchi, 1995; Polanyi, 1966), different knowledge exchange partners and knowledge
sources, various types of innovation, and different spatial dimensions of knowledge transfer relations (Amin & Cohendet, 2004). According to Asheim et al. (2011, p. 898), the threefold distinction:

refers to ideal types, most activities are in practice comprised of more than one knowledge base. The degree to which certain knowledge bases dominates, however, varies and is contingent on the characteristics of firms and industries as well as between different type of activities (for example, research and production).

**Symbolic knowledge base**

Industrial activities that rely on the symbolic knowledge base particularly target the aesthetic attributes of a product, the creation of designs and images as well as the economic use of various forms of cultural artefacts (Asheim, 2007). Creative industries, and the products and services thereof, such as film-making, music, design, fashion, publishing or advertising (De Propris et al., 2009; Scott, 1997) are good examples of economic sectors driven by symbolic knowledge inputs. According to Lash and Urry (1994), the creation of sign-value in these sectors is more important than the mere use-value of products.

Knowledge is therefore incorporated and transmitted in aesthetic symbols, images, (de) signs, artefacts, sounds and narratives. This type of knowledge is strongly linked to a deep understanding of the habits and norms and ‘everyday culture’ of specific social groups, and is, therefore, characterized by a strong tacit component. (Asheim, 2007, p. 226)

Since the development of new products or processes is particularly based on creativity, aesthetic sense, imagination, interpretative and artistic skills rather than on cognitive information processing or the application of scientific rules, formal qualifications and university degrees are often dispensable recruitment criteria (Martin & Moodysson, 2013). Potential employees acquire relevant skills in practice, in a range of steps within the creative process. Assumed that those predominantly tacit capabilities are hard to transfer from one individual to another, the know-who of potential collaborators working in the respective professional community (or community of specialists; Cohendet & Simon, 2007), defines a crucial strategy (Nachum & Keeble, 2003) to combine complementary talents within temporary project settings in a fruitful arrangement (Grabher 2002a, 2002b, 2004). The importance of buzz (Bathelt, Malmberg, & Maskell, 2004) and face-to-face contacts leads to a relatively high sensitivity for spatial proximity between the potential project partners, who often accumulate knowledge through learning by switching ties (Grabher, 2004). Urban environments rather than sparsely populated spaces serve as the appropriate ground for inspiration and acquaintance to people who make the difference in creativity-driven innovation processes (Scott, 1997).

Characterizations of processes within the video game development sector derived from a number of studies (particularly the ones of Tschang and Szczypula, 2006; Cohendet & Simon, 2007; and Oh, 2007) raise expectations that the success of video game development firms’ innovation efforts rely heavily on the symbolic knowledge base.

**Synthetic knowledge base**

Industries that draw on the synthetic knowledge base most often create product and process innovations through the application or (new) combination of already existing
knowledge with the aim to solve a concrete problem that comes up during the interaction with clients and suppliers. Knowledge formation is characterized as a more inductive process, and innovation processes are dominated by incremental steps. This innovation procedure can be seen, for example, in practical work in general, but also in system design, testing, fine tuning and prototyping. According to some examples given in the literature (e.g. Allen & Kim, 2005; or Izushi & Aoyama, 2006), numerous of these activities are present in the video game development industry as well. Generally, interactive learning is dominated by industry-industry links. Research, given it plays a role in a firms’ video game development process at all, is mainly use-oriented even within industry–university relationships. Similar to the symbolic knowledge base, tacit knowledge, which arises from experience gained at the workplace, and through learning by doing, using and interacting, plays a crucial role within innovation processes (Nonaka & Takeuchi, 1995; Polanyi, 1966). Face-to-face contacts facilitate the transfer of engineering-based knowledge with a strong tacit nature (Audretsch, 1998). Thus, firms relying on the synthetic mode facilitate their innovation processes by shortening the spatial distances especially to those of their major knowledge network partners with whom they exchange particularly highly tacit knowledge. Besides on-the-job-training, professional as well as polytechnic schools are important education channels facilitating concrete know-how, craft, and practical skills (Asheim & Coenen, 2005; Asheim, Coenen, Moodysson, & Vang, 2007; Lange & von Streit, 2013).

Analytical knowledge base

Science-based industries particularly rely on the analytical knowledge base. Part of the core activities of firms are basic and applied research as well as systematic product and process development. As a consequence, many of them have their own research department, but also heavily rely on research done by universities or other research-oriented organizations. Innovation processes frequently lead to radically new products or processes, created by deductive cognitive and rational processes as well as formal models. Characteristic examples are scientific discourses or laboratory-based research. Even though face-to-face contacts facilitate the transfer of tacit as well as of codified knowledge components, they are less important for the analytic case. This is due to the higher degree of codification which simplifies the exchange of knowledge across distances. The core of the workforce needs specific university qualifications, such as analytical skills, the ability to abstract, theory building and testing, and documentation (Asheim & Coenen, 2005; Asheim et al., 2007; Lange & von Streit, 2013). So far there is hardly empirical evidence in the literature for expecting the video game development sector to rely on the analytical knowledge base (an exception is the Organisation for Economic Co-operation and Development (OECD), 2005, study highlighting the research and development (R&D) intensity of the video game sector)

In addition to these three knowledge bases often discussed in the literature, procedural knowledge might be particularly relevant in relation to creative industries (Cacciatori et al., 2011; Newell & Simon, 1972). In a broad sense procedural knowledge is regarded as ‘the codification of knowledge about how to perform a role and how to interface with others’, and in more specific sense ‘as knowledge about how to run large multi-projects effectively’ (Cacciatori et al., 2011, pp. 313, 314). System integrators in creative clusters not only posses this knowledge which is crucial in setting up a new project and from which all firms in the cluster benefit, but also convey this knowledge from project to project through time. Two dimensions of procedural knowledge can be
distinguished (see also Cacciatori et al., 2011). First, managerial knowledge as part of procedural knowledge refers to the setting up of projects, teams, and the coordinating and monitoring of game development. Secondly, strategic knowledge as part of procedural knowledge refers to choosing the right project concerning market and technological trends, and to positioning, branding and marketing the game. The latter can be regarded as a key element when correlating knowledge use and production with competitiveness.

Based on these theoretical elaborations on knowledge bases as well as the literature on creative and video game industries, we derive the following six assumptions which will be examined in the following empirical part of the paper:

- Knowledge creation and main rationale: (1) formal qualifications and university degrees are not really necessary as the development of new products is based on creativity, sense and imagination rather than the application of scientific rules, (2) know-who is the main strategy to combine complementary talents for temporary projects.
- Innovation patterns and processes: (3) innovation is developed by recombining existing knowledge, as well as by the creation of new ideas and images.
- Knowledge exchange partners: (4) knowledge partners can be found in spatially concentrated professional communities, often in the form of freelancers, who work with each other to exchange both market and technological related knowledge.
- Knowledge content: (5) a strong tacit component of knowledge is assumed, since knowledge is strongly linked to the understanding of habits and norms and everyday culture.

| Characteristic | Symbolic knowledge base | Synthetic knowledge base | Analytical knowledge base |
|---------------|-------------------------|--------------------------|--------------------------|
| Main rationale | Creativity-based (know-who) | Engineering based (know-how) | Science-based (know why) |
| Knowledge creation | Interactive, informal, creative, problem oriented | Inductive process, applied, problem related | Deductive process, formal models |
| Innovation patterns and process | Innovation by creative recombination of existing knowledge and by creation of new ideas and images | Incremental innovation by application/combination of existing knowledge | Radical innovation by creation of new knowledge |
| Knowledge exchange partners | Interaction in professional communities, learning from youth/street or ‘fine’ culture | Interactive learning with customers and suppliers | Research collaboration between firms (R&D departments) and research organizations |
| Knowledge content | Strong tacit knowledge content (concrete know-how, craft, practical and search skills) | Strong tacit knowledge content (concrete know-how, craft, practical skill) | Strong codified knowledge content (documentation in patents and publications) |
| Spatial proximity | High sensitivity for spatial proximity | High importance of spatial proximity | Low sensitivity for spatial proximity |

Table 1. Summary of the key characteristics of the symbolic, synthetic and analytical knowledge base in a comparative manner.

Sources: Authors’ own modification of Asheim and Gertler (2005) and Moodysson, Coenen, & Asheim (2008).
Spatial proximity: (6) the importance of buzz and face-to-face contacts leads to a high sensitivity for spatial proximity between potential project partners.

Hamburg: the context for computer game development

The Free and Hanseatic City of Hamburg is the second largest city in Germany due to its population of about 1.8 million. Hamburg is located in the very north of Germany close to the North Sea. It is both a city and a federal state. Neighbouring states are Schleswig-Holstein in the north and Lower Saxony in the south (Figure 1). As home of one of Europe’s biggest seaports, Hamburg constitutes a significant hub within the global trading network. Beside the comparatively high employment share of the port-related services, a glance at Hamburg’s overall labour market structure points to a high percentage of the tertiary sector in general, which is clearly above the national average. Thereof, the relatively high share of jobs in business related services stands out most strikingly (HK Hamburg, 2010). Conservative estimates indicate that the creative industries make up around 7% of Hamburg’s total employment rate (Romein & Trip, 2010).

Figure 1. Location of the video game development firms interviewed.
The city is one of Germany’s most important hot spots of the media sector, with particularly high concentrations in publishing and advertisement (Henninger & Mayer-Ahuja, 2005). There is also a well-established information technology sector, and thus the accumulated expertise of both, media and IT provides a potentially fertile basis for the evolution of the interactive game industry.

In fact, Hamburg’s video game sector is, so far, relatively small in terms of labour shares and business volume compared with the overall media and IT sectors in this city. Nevertheless, in recent years its fast growth made Hamburg one of the leading centres for video game development and publishing in Germany (Walz, Seibert, & Mendoza, 2010). Since many of the video game development firms in Hamburg are specialized in online games, which play a growing role within the global video game market (Walz et al., 2010), the cluster can be expected to grow further in the near future. Actually, the headquarters of one of the worlds’ leading developers of browser games are located in Hamburg.

The city’s prominent position within the national context of video game production, however, has to be put in perspective given the rather weak position of Germany at the global level: so far, it is game developers and publishers from the United States, Japan, the UK or Canada that dominate the world market for video games (Teipen, 2008; Walz et al., 2010). Nevertheless, in 2010, revenues of the German video game industry reached €1.6 billion (BIU e.V., 2011).

As can be seen in Figure 1, there are two small-sized concentrations of interviewed video game development firms within Hamburg. The first is located within the district of St. Pauli, well known as a hot spot for entertainment, cultural and creative industries providing various sources of inspiration as well as a multitude of meeting places. Moreover, St. Pauli’s attractiveness for the gaming industry has got a boost due to gamecity:Port, a property serving as a business incubator for video game-related start-ups founded by the cluster initiative gamecity:Hamburg in 2008. The second concentration of video game development firms is located in Barmbek-Süd near the Hamburg University of Applied Sciences (or Fachhochschule/polytechnic) (HAW), surrounded by a relatively ordinary urban environment.

The supportive infrastructure targeting the competitiveness of the video game industry in Hamburg mirrors the typical hierarchical structure of Germany’s federalist institutional support system: on the one hand, firms in Hamburg may profit from the support of the G.A.M.E. Bundesverband der Entwickler von Computerspielen e.V. – the overarching nationally organized business membership organization for video game development firms – which aims at boosting the German video game development industry as a whole. On the other hand, the video game development firms make use of the support activities offered by the locally organized cluster initiative gamecity:Hamburg (Quinke, 2004).

Apart from these membership organizations, attempts have been undertaken to professionalize and formalize the academic education in video game development at the HAW. The curriculum of the Master’s Degree Program Games, for example, focuses on training students in practical skills rather than teaching them scientific rules: Designers are trained in concept art, three-dimensional (3D) animation etc., while computer scientists are introduced to programming games. In addition, the gamecity:Lab Hamburg, co-founded by two departments of the HAW (the Department of Computer Science and the Department of Media Technology; cf. Figure 1) and gamecity:Hamburg aim at facilitating knowledge and technology transfer between industry and academia.
Empirical work

This section presents the empirical work targeting at the video game development cluster of Hamburg. Data and methodology issues will be described in the first subsection. The following subsections each target the knowledge base characteristics discussed in the second subsection (Setting the frame), i.e. knowledge creation and main rationale, innovation patterns and processes, knowledge exchange partners, knowledge content and spatial proximity.

Data and methodology

The case study of Hamburg’s video game development industry cluster is based on standardized interviews with chief executive officers (CEOs) or executives of 20 of a total of 25 firms (i.e. a response rate of 80%) that develop video games (cf. Figure 1). For eight firms, developing games constitutes the exclusive line of business. The remaining 12 video game development firms (hybrids) publish and distribute video games as well. The cluster contains predominantly micro and small enterprises; two are medium sized, whereas one firm – the leading developer and provider of browser games mentioned in the third section – employed nearly 400 salaried persons (in full-time equivalent [FTE]) in 2010. A look at the firm histories reveals the cluster’s highly dynamic entrepreneurship scene: more than half of the video game development firms started their business in Hamburg between 2007 and 2010.

The identification of Hamburg’s video game development studios is based on desktop research. All firm interviews were conducted between May and October 2010, followed by six semi-standardized expert interviews during the first two months in 2011 in order to discuss preliminary results.

We apply a combination of descriptive statistics and network analyses (Wasserman & Faust, 1994). In doing so, this case study contributes to the rich body of research revolving around networking in creative industries (e.g. Grabher, 2004; Johns, 2006; Nachum & Keeble, 2003). Access to both external technological sources and market-related knowledge sources are critical competition factors in modern business (Boschma & Ter Wal, 2007). Market knowledge refers to new market developments, consumer preferences, competitors, product faults and so on. Hence, the network analysis contains not only 148 knowledge interactions targeting technological issues coming up in the process of video game development, but also 164 market-related knowledge flows are analysed. 2

Knowledge creation and main rationale

Typical human capital characteristics deliver a first hint to the particular knowledge base constellation that pushes the video game development firms’ knowledge creation and innovation processes. Particularly striking at first sight is the fact that formalized academic education is not a sine qua non in order to be hired by one of the firms interviewed (Table 2). In fact, many employees are to be found among the remaining share of non-graduates who started academic studies, but in the end dropped tertiary education to turn passion into career as soon as possible. Nevertheless, nearly six out of 10 employees have at least a bachelor’s degree, most of them in technical, engineering-based studies, first of all in software engineering (Table 2). Artistic studies define another crucial ingredient within the human capital pool of Hamburg’s gaming industry. Such academic programmes rather concentrate on developing the student’s creativity and the ability to
create symbolic and aesthetic value in, for example, media, arts or literature. Those are exactly the capabilities that video game development firms try to integrate into the game development process in order to get the best out of the gameplay, the story, the graphics and the audio elements. Education in natural sciences, which refers stronger to the know-why than to the know-how mode of knowledge patterns, is relatively unimportant. Finally, at least every 10th employee having a university degree was educated in other subjects, such as business administration. Video game development firms frequently integrate this sort of competences at the management level.

The dominance of certain recruitment sources is another indicator for the constellation of knowledge bases used in Hamburg’s video game development sector. Table 3 shows most important recruitment sources for highly qualified labour. First, raising the innovative potential by strengthening cross-sectoral labour mobility does obviously not belong to the core human resources strategies. This limited cross-sectoral labour mobility might be caused by the rather homogeneous educational (software engineering) as well as vocational background of the entrepreneurs in the cluster (most of them are spin-offs from the leading firm in the cluster). In the face of Hamburg’s well-established media and software sectors surrounding the video game cluster, so far, the video game development firms seem to have missed the opportunity to profit more from inter-sectoral exchange of embodied brain power with geographically and technologically neighboured industries.

Secondly, even though half of the interviewed firms value universities as ‘important’ or ‘very important’ recruitment sources, they clearly play a minor role in comparison with universities of applied sciences. This finding fits to the interpretation of the employees’ educational level (Table 2): video game development studios in Hamburg

Table 2. Educational level of employees of video game development firms (n = 20) in Hamburg.

| Educational background                                      | %   |
|------------------------------------------------------------|-----|
| Higher than or equal to a bachelor’s degree                | 58.5|
| thereof:                                                   |     |
| Engineering (above all software engineering)               | 56.2|
| Artistic studies (e.g. arts, media, graphic design)       | 27.4|
| Natural sciences                                           | 6.3 |
| Others (e.g. business studies)                             | 10.1|
| Lower than a bachelor’s degree                             | 41.5|
| Total                                                      | 100.0|

Table 3. Recruitment sources for video game development firms (n = 19) in Hamburg.

| Recruitment source                                | ‘Very important’/% ‘important’ (%) | Average importance¹ |
|--------------------------------------------------|-----------------------------------|---------------------|
|                                                  |                                   | Regional | National | International |
| Universities of applied sciences                  | 73.7                              | 3.6      | 3.3      | 1.9           |
| Firms of same sector                             | 68.4                              | 3.8      | 3.5      | 2.0           |
| Universities                                    | 47.4                              | 3.1      | 3.2      | 2.1           |
| Firms of different sectors                       | 0.0                               | 2.2      | 2.0      | 1.4           |
| Average                                         | 3.2                               | 3.0      | 1.9      |               |

Notes: ¹The German ‘Fachhochschulen’ (universities of applied sciences) are comparable with technical colleges or polytechnics in other countries.
²¹ = not important, 5 = very important.
generally prefer to recruit graduates showing strengths, above all, in the application of knowledge to solve a concrete, product-related problem. Universities of applied sciences offer the adequate learning environment to increase the corresponding know-how. Graduates from universities, who focused on the analytical and science-based range of expertise during their academic education, are ranked minor, suggesting that the analytical knowledge base might be less important than the synthetic one.

Thirdly, attracting talents from competitors defines another major line of recruitment activities of the firms. Such a strategy helps them to learn (indirectly) from their competitors. Given the assumption that firms of the same industry are driven by, in general, similar knowledge base configurations (cf. the second section), intra-sectoral labour pooling leads to a deepening of already existing knowledge base constellations rather than altering them.

According to the spatial organization of labour pooling for highly talented people there is a strong focus on the local/regional and national labour market, which provokes two lines of explanation: Hamburg, and the rest of Germany, may provide sufficient talents and therefore it is not necessary to recruit staff from abroad. Another explanation may be that it is hard for German video game development firms to attract high potentials from abroad, due to the fact that Germany does not belong to the leading countries in video game development which can offer better career opportunities.

In sum, the video game development firm’s human resources and recruitment strategy particularly aims at acquiring embodied, applied, engineering and creativity based knowledge. This policy hints to a symbolic–synthetic knowledge base combination to be the crucial driver for innovation in Hamburg’s video game development cluster.

**Innovation patterns and processes**

The analysis of the firm’s innovation activities gives rise to further indicators for the knowledge mixture that drives the video game development cluster. The development of video games and related processes is the core of innovation efforts, mentioned by 16 of the 20 firms. These activities are mostly custom-tailored rather than standardized by nature. Eleven firms highlight the design of the video game as belonging to their main activities to achieve competitiveness. Marketing their own video games defines another crucial task for at least every second firm. These outcomes show that the central activities for staying competitive depend on a multitude of competences, mixing (high-)technology expertise with commercial know-how and abilities with reference to cultural interpretation.

Additional innovation and research and development (R&D)-related indicators show the following: (1) The highest shares of the firms’ turnovers result from both the sale of slightly changed games – reflecting the incremental path of innovation – and the sale of entirely new developed games – representing the radical mode of innovation. Whereas the incremental mode is typical for the synthetic knowledge base in action, the high relevance of radical innovations defines a characteristic feature of the analytical knowledge base. (2) Furthermore, 17 out of 20 video game development studios indicated to employ R&D employees (i.e. personnel that is primarily occupied with the development of new video games), namely 27 (FTE) on average and five (FTE) as the median number, all organized in a distinct R&D department. Within the remaining three firms, which do not employ any full-time R&D staff, each worker dedicates nearly half of his/her working time to R&D. However, the emphasis within R&D refers more to the D-part by highlighting the (software) engineering-based process of video game
development. Usually, basic science-oriented or applied research (the *R-part*) does not belong to the core work of R&D employees in this sector. (3) Finally, a view at the firms’ patent statistics underlines the rather weak influence of the analytical knowledge base: the fact that none of the analysed firms applied for a patent protection might be interpreted in a way that knowledge used to develop a video game is not patentable, because it is hardly codifiable.\(^4\)

**Knowledge exchange partners**

The distinction between technological and market related knowledge provides a fine-grained picture of the video game development firms’ knowledge exchange relations. The corresponding network analysis helps to find out with whom, and across what distances they share these different types of knowledge.\(^5\) At the same time, these insights provide a capable basis for determining the crucial knowledge base configuration that drives video game development within the cluster. Due to the focus on the *whole system* of knowledge linkages within and beyond the cluster’s boundaries (Figures 2 and 3), the related data following hereafter is of an aggregated nature and does not necessarily reflect the knowledge network structure of one particular firm.

**Interactive learning between Hamburg’s video game developers**

Before we take a look at all the already mentioned contacts below, Table 4 first presents a range of *sociocentric* network indicators,\(^6\) concentrating on the knowledge flows identified between the 20 interviewed firms themselves.

---

**Figure 2.** Technological knowledge network of video game development firms (*n* = 20) in Hamburg.

Source: UCINET 6, elaborations based on the authors’ own research data.
The network density – calculated as a ratio between the actual number of ties and the potential maximum number of ties (Wasserman & Faust, 1994) – is at least 0.0289 for the technological knowledge network (TKN) (i.e. 2.9% of all potential inter-firm relationships between the interviewed firms are exploited), and 0.0614 (6.1%) for the market knowledge network (MKN). In general, these figures prove that interactive learning between Hamburg’s video game development firms takes place at a medium level. Especially with regard to the MKN, we can conclude that numerous potential gatekeepers (Giuliani & Bell, 2005; Graf, 2011) distribute relevant knowledge for innovation processes throughout the cluster. The TKN is less dense than the MKN, which might be explained by the fact that the relatively time-consuming projects (compared with other

Figure 3. Market knowledge network of video game development firms \( (n = 19) \) in Hamburg. Source: UCINET 6, elaborations based on the authors’ own research data.

Table 4. Knowledge flows between 20 video game development firms for the technological knowledge network and 19 video game development firms for the market knowledge network in Hamburg: summary of sociocentric network indicators.

| Indicator                        | Technological knowledge network \( (n = 20) \) | Market knowledge network \( (n = 19) \) |
|----------------------------------|-----------------------------------------------|----------------------------------------|
| Number of ties                   | 11                                            | 21                                     |
| Density                          | 0.0289                                        | 0.0614                                 |
| Components                       | 10                                            | 4                                      |
| In-degree centralization/dicho    | 0.0803                                        | 0.2870                                 |
| In-degree centralization/valued   | 0.0360                                        | 0.1643                                 |
| Out-degree centralization/dicho   | 0.1357                                        | 0.1111                                 |
| Out-degree centralization/valued  | 0.0914                                        | 0.0764                                 |
creative industries) require a longer period of constant interaction among team members (Tschang & Vang, 2008). In combination with the need for secrecy, this form of work, Tschang and Vang (2008) conclude, favours hierarchy-based governance modes and in-house storage of technological knowledge rather than sharing it with other video game development studios.

A glance at the number of network components reveals that the TKN connecting Hamburg’s video game development studios is relatively fragmented, whereas the MKN is not: the TKN consists of 10 out of potentially 20 components, thereof one connecting nine nodes, another one linking three. The MKN consists of four of maximum 19 components, thereof a major one linking 16 firms.

The centralization index determines the extent of hierarchy within both networks. Except for the in-degree centralization measures concerning the MKN, both networks are relatively homogeneous in hierarchical structure.7

By combining the aforementioned network indicators we may conclude that for the exchange of technological knowledge the uniformity of network positions is situated on a modest level of interactive learning between the interviewed video game development firms. Market related knowledge circulates more intensely within this community, and the MKN is stronger geared to a few highly connected firms.

Now what can we learn from these indicators in the face of the underlying knowledge base? They show that knowledge sharing with more or less direct competitors constitutes a crucial strategy for a number of Hamburg’s video game development studios. Spatially concentrated communities of specialists (Cohendet & Simon, 2007) do exist within the cluster. This is typical for industries relying on the symbolic knowledge base. However, these specialists trade particularly market related information, whereas the exchange of knowledge targeting technological aspects is, so far, less intensive.

**Contact types**

Turning to the aggregated examination of the firms’ entire egocentric knowledge networks8 and leaving the sociocentric perspective, every relation was further differentiated according to the type of knowledge exchange partners (Table 5).

To start with the exchange of technological knowledge, we observe that freelancers, specialized in different steps of the video game development process, are, by quantity and quality, the most important actors within the TKN of Hamburg’s video game development firms (see also Figure 2).9 These freelancers are highly mobile network actors (Lange & von Streit, 2013) who, in the Hamburg case, mostly work exclusively for a single video game development studio, yet on a temporary project basis (Grabher, 2002a). As soon as these projects come to an end and new ones emerge, the freelancers change their position within the TKN, and new network constellations evolve. Hamburg’s video game development studios potentially profit from such reconfiguring relationships: Although they accumulate knowledge through learning by switching ties (Grabher, 2004), this process is less intense in the video game development industry compared to those creative industries with shorter project periods (Tschang & Vang, 2008). A precondition for this mode of learning is the know-who of potential collaborators to combine complementary, often highly tacit and embodied knowledge components in a productive way.

Competitors, composed of developers and hybrids in equal parts, constitute the second biggest group of knowledge exchange partners within the TKN of Hamburg’s video game development firms. In combination with the high share of interactions with
freelancers, knowledge relations with competitors define the core of the community’s network. However, the comparatively low average importance ascribed to competitors points to a rather loose technology transfer of rather low strategic impact. Interactive learning with suppliers, in particular component developers (i.e., firms specialized in delivering video game components, like enabling software, sound, animation, graphics, etc.), comprises nearly every fifth TKN contact, whereas fewer than every sixth relation refers to customers. In sum, the distribution of contact types within the video game development firms’ TKN – reflecting the decisive role of freelancers, supplemented by knowledge transfers along the value chain – mirrors the typical knowledge exchange partners representing the symbolic knowledge base on the one hand and the synthetic knowledge base on the other hand. Due to the low percentage of TKN ties with university departments or other research organizations, the analytical knowledge base plays a minor role in this cluster.

According to their share of all contact types, customers are the dominating partners for Hamburg’s video game development firms within the MKN. Nearly half of all knowledge transfers related to market aspects refer to this type of contact. A closer look at the data presented in Table 5 reveals that, within the group of customer contacts, it is mainly the publishers and internet service providers with whom the firms exchange strategic market information. Out of the video game developments’ viewpoint these companies are closer to the market, predestined to deliver information in reference to, for example, latest market trends, consumer preferences, and competitor strategies. At least every fourth MKN contact refers to competitors, which is slightly more than the corresponding share mentioned for the TKN. Among the competitors it is particularly the

Table 5. Contact types within the technological knowledge and market knowledge network.

| Contact type       | Technological knowledge network | Market knowledge network |
|--------------------|---------------------------------|--------------------------|
|                    | \(n\) | %  | AvImp | \(n\) | %  | AvImp |
| Supplier           | 28    | 18.9 | 3.4   | 6     | 3.7 | 2.5   |
| CoD                | 18    | 12.2 | 2.8   | 5     | 3.0 | 2.8   |
| Dev                | 10    | 6.8  | 4.3   | 1     | 0.6 | 1.0   |
| Freelancer         | 38    | 25.7 | 3.5   | 10    | 6.1 | 3.0   |
| Competitor         | 30    | 20.3 | 2.5   | 41    | 25.0| 2.7   |
| Dev                | 16    | 10.8 | 3.4   | 11    | 6.7 | 2.8   |
| Hyb                | 14    | 9.5  | 1.6   | 30    | 18.3| 2.7   |
| Customer/distributor | 23   | 15.5 | 3.5   | 77    | 47.0| 2.9   |
| Hyb                | 0     | 0.0  | –     | 9     | 5.5 | 2.8   |
| Pub                | 4     | 2.7  | 2.3   | 29    | 17.7| 2.8   |
| ISP                | 3     | 2.0  | 4.0   | 30    | 18.3| 2.7   |
| Other              | 16    | 10.8 | 3.7   | 9     | 5.5 | 4.1   |
| Uni/ROG            | 13    | 8.8  | 3.2   | 4     | 2.4 | 2.5   |
| Other              | 16    | 10.8 | 3.2   | 26    | 15.9| 3.6   |
| BMO/BDA            | 10    | 6.8  | 2.6   | 17    | 10.4| 3.2   |
| Other              | 6     | 4.1  | 4.2   | 9     | 5.5 | 4.2   |
| Total              | 148   | 100.0| 3.2   | 164   | 100.0| 2.9   |

Note: \(n\), Number of knowledge links; AvImp, average importance for firms’ innovation performance (1 = not important, 5 = very important); CoD, component developers; Dev, developers of video games; Hyb, firms that both develop and publish video games; Pub, publishers of video games; ISP, internet service providers; BMO/BDA, business membership organizations/business development agencies.
hybrids which, due to their experience in publishing games, belong to the most interesting MKN partners. The low weight of supplier relations underlines the picture of a ‘centre of gravity’ that, in comparison with the TKN, moves further to the customer side of the value chain. Finally, business membership organizations, first of all the local cluster initiative gamecity:Hamburg (cf. the third section), belong to the most important providers of market knowledge. Gamecity:Hamburg bundles numerous MKN relations, functioning as the key knowledge broker throughout the network. Particularly its quarterly organized business gathering provides a highly frequented networking opportunity, bringing creative heads together in a laid-back atmosphere of bars and club environments.

Knowledge content

The information given in Table 6 stresses that technology-oriented knowledge interactions are clearly oriented towards the applied and problem related dimension of knowledge used in video game development. Only very few firms in this sector cultivate relationships in order to absorb scientific expertise by, for example, integrating formal models. The focus on sourcing for applied, practical-oriented knowledge, again, underlines the firm’s dependence on synthetic and symbolic knowledge assets at the same time.

Spatial proximity

Table 7 distinguishes between locally/regionally bounded knowledge linkages and those transcending the national and European boundaries. Most knowledge exchanges occur with network partners in close distance, which is typical for industries with predominantly synthetical and symbolic activities. Nearly every second knowledge flow stays within Hamburg itself, no matter if they refer to market or to technological aspects.

This finding goes in line with the assumption that knowledge creation processes of creative businesses are particularly anchored in local contexts which are capable to provide a buzz-like atmosphere (Bathelt et al., 2004) of creative ideas and knowledge spillovers. Hamburg’s urban environment obviously serves this fertile ground (Scott, 1997), guaranteeing the video game development firms to profit from the interaction in locally or regionally bounded professional communities (Cohendet & Simon, 2007). Moreover, developing video games requires frequently repeated face-to-face interactions to permanently exchange ideas and negotiate further steps. Before publishing the game, the typical interactive steps of video game development are planning, scenario writing,

Table 6. Characteristics of knowledge flows.

| Knowledge content | N   | %    |
|-------------------|-----|------|
| Practical         | 138 | 93.2 |
| Scientific        | 3   | 2.0  |
| Both              | 7   | 4.7  |
| Total             | 148 | 100.0|

Note: *n*, Number of knowledge links; AvImp, average importance for firms’ innovation performance (1 = not important, 5 = very important).
developing graphics and sounds, programming, synthesizing graphics, sounds and programming, game testing, debugging, and beta testing (Oh, 2007). If a video game development firm does not have all these knowledge ingredients in-house, it profits from the spatial proximity to cooperators, suppliers, customers and freelancers, facilitating the collaborative developing process.

Modern video game development requires sourcing for globally distributed knowledge as well, which is simplified through global virtual networks (Cairncross, 1997). Due to the growing importance in this industry to widen marketing potentials, the need for knowledge sourcing on a global scale applies particularly to the MKN. Although networking is, by quantity, notably vivid at the regional and national level of the TKN, the resulting knowledge flows rank lower in importance (concerning the firm’s innovation performance) compared to international linkages. One explanation for this discrepancy between quality and quantity might be due to the inferior role of Germany within worldwide video game development (cf. the third section). As a consequence, the firms are forced to source abroad and build up global pipelines (Bathelt et al., 2004) in order to get access to cutting-edge technological expertise. However, given that the strength of weak ties – paradox observed by Granovetter (1973) applies for this case study as well, the low rank of regional and national TKN contacts is not necessarily disadvantageous for the firms’ innovative performances per se: according to Granovetter, weak ties often function as key mechanisms to mobilize ideas and information, in order, for example, to launch new products, or to solve a particular problem.

Conclusions

The first aim of this paper was to analyse which knowledge base drives the video game development cluster in Hamburg. Based on the assumptions listed at the end of the second section and the empirical examination of them, one central outcome of this paper is that it is both, the synthetic and the symbolic knowledge, and less the analytical one which drives video game development in Hamburg. This mixed result fits well to the existing literature on video game development, which indicates that both technological as well as the creative competences are to be brought together in the video game development process (Izushi & Aoyama, 2006; Tschang & Szczypula, 2006; Oh, 2007; Peltoniemi, 2009). It hence draws rather ambiguous pictures of the mix ratio of both knowledge ingredients, i.e. the question concerning which knowledge base lies at the centre of the video game development firms’ competitiveness.

Table 7. Geography of the technological knowledge and market knowledge network.

| Geographical scale | Technological knowledge network | Market knowledge network |
|--------------------|---------------------------------|--------------------------|
|                    | \(n\) | %   | AvImp | \(N\) | %   | AvImp |
| Hamburg            | 73    | 49.3 | 2.9   | 68    | 41.5 | 2.8   |
| Germany            | 45    | 30.4 | 3.1   | 36    | 22.0 | 3.3   |
| Europe             | 17    | 11.5 | 3.9   | 28    | 17.1 | 2.6   |
| Global             | 13    | 8.8  | 4.3   | 32    | 19.5 | 3.1   |
| Total              | 148   | 100.0| 3.2   | 164   | 100.0| 2.9   |

Note: \(n\), Number of knowledge links; AvImp, average importance for firms’ innovation performance (1 = not important, 5 = very important).
The second aim was to assess the analytical power of knowledge bases for examining knowledge characteristics, innovativeness and competitiveness of creative industries. A major strength of the knowledge base concept is certainly the systematic way it disentangles the complexity of economic action as well as underlying knowledge and innovation processes. However, it clearly lacks the power to analyse and explain the competitiveness of creative industries. The knowledge base literature expects that innovativeness will automatically lead to performance, value-creation and competitiveness (Asheim et al., 2011), which is much less the case in creative industries than in manufacturing industries. It is particularly procedural knowledge which can be considered as the missing element to explain these differences in competitiveness in the often project-based creative industries. Since managerial capacities with procedural knowledge are key to understand the competitiveness of creative industries, they should play a pivotal role in future research on creative industries.

In addition to the lacking focus on procedural knowledge and managerial capacities, we see two other main limitations of the empirical research on knowledge bases. First, the knowledge base perspective is relatively static in its approach: when the case study was carried out has repercussions for the results. The type of knowledge which constitutes the competitive core of one and the same video game development cluster changes over time, which may be due to shifting customer demands, or caused by the emergence of new technologies. These changes could, in turn, lead to new network structures. A fruitful future research objective could be to include evolutionary perspectives on economic action in order to pay more attention to the fact that products, processes, technologies etc. change over time, and, coincidently, the knowledge inputs (i.e. the knowledge base(s)) that are needed. Moreover, not only knowledge as an asset changes over time, but also knowledge as a capability. The proposed epistemological paradigm of evolutionary economic geography (cf. Boschma & Frenken, 2011) might serve as a fertile ground in order to pay more attention to these dynamics in creative industries (see also Berg & Hassink, 2014). Another promising avenue is the recent micro-level research describing how innovations are realized in companies over time through combining varying knowledge bases with the help of the knowledge biography method (e.g. Manniche & Testa, 2010; Manniche, 2012; Strambach, 2012).

Secondly and finally, methodologically, there are clearly limits of using only quantitative data within a research context that does not only deal with ‘hard facts’ (e.g. patent numbers), but also points to the ‘soft architecture’ of the firm’s knowledge bases (e.g. relations between actors). The main limit of quantitative data relates to the identification of the type of crucial knowledge that is critical for the firms’ competitiveness. We tried to diminish this kind of ‘interpretation problem’ by complementing the quantitative data with qualitative information by industry experts. Moreover, there are constraints of network analyses, particularly, that interviewees were asked in an open question to mention preferably all the actors their firms exchange knowledge with, we generated data on ego-networks but not on so-called complete (or: socio-centric) networks. Another limitation concerns the missing differentiation of the knowledge network relations according to their degree of formalization (formal versus informal), as well as differentiation of network governance modes (hierarchy, networks, projects).

Notes
1. DFC Intelligence (2008) forecasted that global revenues from video game hardware and software would reach US$57 billion in 2009.
2. Since one interviewee refused to name the firm’s market knowledge network partners, the size of the firm sample for the market knowledge network is $n = 19$ instead of $n = 20$.

3. Design, as it is defined here, stands for the creativity-driven development of visually based aesthetic values.

4. Given that patenting video game software would be possible at all, many interviewees mentioned that protection mechanisms such as these are rather seen as a no go in the video game development community. Due to their opinion, patents would hamper the rapid development of the gaming industry for years.

5. What exactly a network is made of and which kind of questions were asked to obtain this information is described in detail in Plum (2011).

6. Everett and Borgatti (2005, p. 32) suggest being cautious in interpreting sociocentric indicators of ego networks and refer to several problems, such as those related to eigenvector centrality.

7. Within the intra-regional market knowledge network, three firms, namely DE002, DE006 and DE011, exhibit comparatively high in-degrees (Figure 3).

8. ‘Ego networks are networks consisting of a single actor (ego) together with the actors they are connected to (alters) and all the links among those alters. [...] Information on the alters, including how they are connected, is usually obtained entirely from ego’ (Everett & Borgatti, 2005, p. 31).

9. The group of freelancers in the video game sector includes, for example, game, graphic and sound designers, software engineers, computer animators, or compositors.

10. Assuming that the analysis of interactive learning between Hamburg’s VGD firms themselves (see the first part of the fourth section) includes gamecity:Hamburg as well, network indicators – especially those describing the market knowledge network structure – would indicate an even higher density of knowledge flows within Hamburg’s video game development industry.

References
Aage, T., & Belussi, F. (2008). From Fashion to design: creative networks in industrial districts. Industry and Innovation, 15(5), 475–491.
Allen, J. P., & Kim, J. (2005). IT and the video game industry: tensions and mutual shaping. Journal of Information Technology, 20, 234–244.
Amin, A., & Cohendet, P. (2004). Architectures of knowledge: Firms, capabilities, and communities. Oxford: Oxford University Press.
Asheim, B.T. (2007). Differentiated knowledge bases and varieties of regional innovation systems. Innovation: European Journal of Social Sciences Research, 20(3), 223–241.
Asheim, B. T., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: platform policies based on related variety and differentiated knowledge bases. Regional Studies, 45(7), 893–904.
Asheim, B. T., & Coenen, L. (2005). Knowledge bases and regional innovation systems: comparing Nordic clusters. Research Policy, 34(8), 1173–1190.
Asheim, B. T., Coenen, L., Moodysson, J., & Vang, J. (2007). Constructing knowledge-based regional advantage: implications for regional innovation policy. International Journal of Entrepreneurship and Innovation Management, 7(2–5), 140–155.
Asheim, B. T., & Gertler, M. S. (2005). The geography of innovation: regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), The Oxford Handbook of Innovation (pp. 291–317). Oxford: Oxford University Press.
Audretsch, D. B. (1998). Agglomeration and the location of innovative activity. Oxford Review of Economic Policy, 14(2), 18–29.
Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. Progress in Human Geography, 28(1), 31–56.
Berg, S.-H., & Hassink, R. (2014). Creative industries from an evolutionary perspective: a critical literature review. Geography Compass, 8(9), 653–664.
BIU e.V. (2011). Marktzahlen Computer- und Videospiele Gesamtjahr 2010. Datenerhebung: GfK Panel Services Deutschland. Berlin: Bundesverband Interaktive Unterhaltungssoftware.
Boggs, J. (2009). Cultural industries and the creative economy – vague but useful concepts. Geography Compass, 3(4), 1483–1498.
Boschma, R., & Frenken, K. (2011). The emerging empirics of evolutionary economic geography. *Journal of Economic Geography, 11*(2), 295–307.

Boschma, R. A., & Ter Wal, A. L. J. (2007). Knowledge networks and innovative performance in an industrial district: the case of a footwear district in the south of Italy. *Industry and Innovation, 14*(2), 177–199.

Cacciatori, E., Tamoschus, D., & Grabher, G. (2011). Knowledge transfer across projects: codification in creative, high-tech and engineering industries. *Management Learning, 43*(3), 309–331.

Cadin, L., & Guérin, F. (2006). What can we learn from the video games industry? *European Management Journal, 24*(4), 248–255.

Cairncross, F. (1997). *The death of distance: How the communications revolution will change our lives*. Cambridge, MA: Harvard Business School Press.

Caves, R. E. (2000). *Creative industries: Contracts between art and commerce*. Cambridge, MA: Harvard University Press.

Cohendet, P., & Simon, L. (2007). Playing across the playground: paradoxes of knowledge creation in the videogame firm. *Journal of Organizational Behavior, 28*(5), 587–605.

De Propris, L., Chapain, C., Cooke, P., MacNeill, S., & Mateos-Garcia, J. (2009). The geography of creativity (Interim Report). London: National Endowment for Science, Technology and the Arts (NESTA).

DFC Intelligence (2008). DFC Intelligence forecasts video game market to reach $57 billion in 2009. Retrieved from [http://www.dfcint.com/wp/?p=222](http://www.dfcint.com/wp/?p=222). (accessed on March 25, 2011).

Dyer-Witheford, N., & Sharman, Z. (2005). The political economy of Canada’s video and computer game industry. *Canadian Journal of Communication, 30*(2), 1–10.

Everett, M. G., & Borgatti, S. P. (2005). Ego-network betweenness. *Social Networks, 27*(1), 31–38.

Florida, R. (2002). *The rise of the creative class and how it’s transforming work, leisure, community and everyday life*. New York, NY: Basic.

Giuliani, E., & Bell, M. (2005). The micro-determinants of meso-level learning and innovation: evidence from a Chilean wine cluster. *Research Policy, 34*(1), 47–68.

Grabher, G. (2002a). Cool projects, boring institutions: temporary collaboration in social context. *Regional Studies, 36*(3), 205–214.

Grabher, G. (2002b). Fragile sector, robust practice: project ecologies in new media. *Environment and Planning A, 34*(11), 1911–1926.

Grabher, G. (2004). Learning in projects, remembering in networks?: communality, sociality, and connectivity in project ecologies. *European Urban and Regional Studies, 11*(2), 99–119.

Grabher, G., & Ibert, O. (2006). Bad company? The ambiguity of personal knowledge networks. *Journal of Economic Geography, 6*(3), 251–271.

Graf, H. (2011). Gatekeepers in regional networks of innovators. *Cambridge Journal of Economics, 35*(1), 173–198.

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology, 78*(6), 1360–1380.

Henninger, A., & Mayer-Ahuja, N. (2005). *Arbeit und Beschäftigung in den Hamburger Creative Industries*. Vienna: Forschungs-u. Beratungsstelle Arbeitswelt.

HK Hamburg, (2010). *Zahlen 2009/2010*. Hamburg: Handelskammer Hamburg.

Izushi, H., & Aoyama, Y. (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. *Environment and Planning A, 38*(10), 1843–1861.

Johns, J. (2006). Video games production networks: value capture, power relations and embeddedness. *Journal of Economic Geography, 6*(2), 151–180.

Laestadius, S. (1998). Technology level, knowledge formation and industrial competence in paper manufacturing. In G. Eliasson, & C. Green (Eds.), *Micro foundations of economic growth* (pp. 212–226). Ann Arbor: University of Michigan Press.

Lange, B., & von Streit, A. (2013). Governance of creative industries. A comparison of the characteristics and challenges in the software/games industry in Munich and Leipzig. *Zeitschrift für Wirtschaftsgeographie, 57*(3), 122–138.

Lash, S., & Urry, J. (1994). *Economies of signs and space*. London: Sage.

Lazzeretti, L., Boix, R., & Capone, F. (2008). Do creative industries cluster? Mapping creative local production systems in Italy and Spain. *Industry and Innovation, 15*(5), 549–567.
Manniche, J. (2012). Combinatorial knowledge dynamics: on the usefulness of the differentiated knowledge bases model. European Planning Studies, 20(11), 1824–1841.

Manniche, J., & Testa, S. (2010). Knowledge bases in worlds of production: the case of the food industry. Industry and Innovation, 17(3), 263–284.

Martin, R., & Moodysson, J. (2011). Innovation in symbolic industries: the geography and organisation of knowledge sourcing. European Planning Studies, 19(7), 1183–1203.

Martin, R., & Moodysson, J. (2013). Comparing knowledge bases: on the geography and organization of knowledge sourcing in the regional innovation system of Scania. Sweden. European Urban and Regional Studies, 20(2), 170–187.

Moodysson, J., Coenen, L., & Asheim, B. T. (2008). Explaining spatial patterns of innovation: analytical and synthetic modes of knowledge creation in the Medicon Valley life-science cluster. Environment and Planning A, 40(5), 1040–1056.

Nachum, L., & Keeble, D. (2003). Neo-Marshallian clusters and global networks: the linkages of media firms in Central London. Long Range Planning, 36(5), 459–480.

Newell, A., & Simon, H. A. (1972). Human problem solving, Vol. 14. Englewood Cliffs: Prentice-Hall.

Nonaka, I., & Takeuchi, H. (1995). The knowledge-creating company: How Japanese companies create the dynamics of innovation. New York, NY: Oxford University Press.

Oh, E. (2007). Project organization, diverse knowledge, and innovation systems in the Korean game software industry. Atlanta: Georgia Institute of Technology.

Organisation for Economic Co-operation and Development (OECD) (2005). Digital broadband content: The online computer and video game industry. Paris: OECD.

Peltoniemi, M. (2009). Industry life-cycle theory in the cultural domain: Dynamics of the Games Industry. Tampere: Tampere University of Technology.

Plum, O. (2011). Developing biotech products, making cars, creating video games: Disentangling knowledge bases in three German regions (Doctoral dissertation). University of Kiel.

Polanyi, M. (1966). The tacit dimension. New York: Doubleday.

Quinke, A. (2004). GameCity Hamburg. Konzept zur Förderung der Computerspiele-Wirtschaft in Hamburg. Hamburg: TU-Hamburg Harburg.

Rantisi, N. M. (2002). The Local innovation system as a source of ‘variety’: openness and adaptability in New York City’s Garment District. Regional Studies, 36(6), 587–602.

Romein, A., & J.J. Trip. (2010). The creative economy in CCC cities and regions. Delft: Delft University of Technology, OTB Research Institute for the Built Environment.

Scott, A. J. (1997). The cultural economy of cities. International Journal of Urban and Regional Research, 21(2), 323–339.

Sedita, S. R. (2008). Interpersonal and inter-organizational networks in the performing arts: the case of project-based organizations in the live music industry. Industry and Innovation, 15(5), 493–511.

Staber, U. (2008). Network evolution in cultural industries. Industry and Innovation, 15(5), 569–578.

Storz, C. (2008). Dynamics in innovation systems: evidence from Japan’s game software industry. Research Policy, 37(9), 1480–1491.

Strambach, S. (2012) Knowledge dynamics and knowledge commodification of KIBS in time and space. In E. Di Maria, R. Grandinetti, & B. Di Bernardo (Eds), Exploring knowledge-intensive business services. Knowledge management strategies (pp. 56–78). Basingstoke: Palgrave Macmillan.

Teipen, C. (2008). Work and employment in creative industries: the video games industry in Germany, Sweden and Poland. Economic and Industrial Democracy, 29(3), 309–335.

Tschang, F. T., & Szczypula, J. (2006). Idea creation, constructivism and evolution as key characteristics in the videogame artifact design process. European Management Journal, 24(4), 270–287.

Tschang, F.T., & Vang, J. (2008). Explaining the spatial organization of creative industries: the case of the U.S. videogames industry. In Danish Research Unit for Industrial Dynamics/ Dynamics of Institutions & Markets in Europe (DRUID/DIME) 25th Celebration Conference 2008, Copenhagen, Denmark.

Venkatraman, N., & Lee, C.-H. (2004). Preferential linkage and network evolution: a conceptual model and empirical test in the U.S. video game sector. Academy of Management Journal, 47(6), 876–892.
Walz, S.P., Seibert, T., & Mendoza, E. (2010). Analyse der Games-Branchenstruktur in Baden-Württemberg. Markt, Akteure, Interaktionen: Handlungsempfehlungen zur nachhaltigen wirtschaftspolitischen Unterstützung einer Zukunftsbranche. Stuttgart: Innovationsagentur für IT und Medien des Landes Baden-Württemberg.

Wasserman, S., & Faust, K. (1994). Social network analysis: Methods and applications. Cambridge: Cambridge University Press.