Insights from Social Network Analysis  Case Board Interlocks in Finnish Game Industry

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Abstract—In the world of networked innovation and ecosystems, flows of resources into the organization as well as between organizations are emphasized. This allows for using network measures for better understanding. In this study, we look at the case context of Finnish game industry, concentrating especially on inter-organizational flows of board networks or interlocks, and the possibilities of using SNA metrics for insights. The game industry has been very successful, with a turnover of 1.8 Billion Euros in 2014, and we explore the role of board interlocks in it. Our findings of the formal board member networks indicate that in contrast to the assumptions of high degree or node level metrics (degree and betweenness centrality) and the network level metrics (density and clustering), board interlocks are limited.

Keywords—ecosystems; board interlocks; social network analysis

I. INTRODUCTION

In the modern approaches of looking at innovation and economic growth, it is widely recognized that no one can do it alone; rather we talk about open innovation, networked economies and ecosystems. Networks embody a relational rather than a transactional or atomistic view of the organization and this brings new challenges of understanding more about the origins, evolution and management of relationships, as well as how they can confer competitive advantage [1], and hence the emphasis on networks and systems calls for recognition for flows of people, money and knowledge. Networks are generally described by connections or social links [2] and within the context of innovation and economic growth, as nested structures of individuals, firms and their relationships [3].

With the rapidly emerging and highly interdisciplinary synthesis of new analytical techniques, enormous greater computing power and an unprecedented volume of empirical data [4], there now are novel possibilities for exploring the role of networks for creating value. For example, a recent term of computational social science has been introduced to address this investigation of social systems and dynamics in a qualitative way through large datasets, either mined from various sources (e.g. social media, communication systems), or created via controlled experiments. One major methodology is social network analysis (SNA), which maps and measures the relationships and flows between connected nodes [5] and has been used to study the sociological relationships of people and organizations [6]. SNA is increasingly being used for revelation of patterns of connections and interactions [7]. Furthermore, [8] have shown that understanding the structure of a network is key factor in the controllability of both engineered and real complex networks.

In this paper, we concentrate on board interlocks, which refer to holding of multiple directorships in companies that are not hierarchically managed, creating view into the explicit networks of companies. Board members are of specific interest due to the impact they have on performance [9], [10]. This impact draws from the role of board members in ensuring inter-organizational flows, as their function is not only to ratify management initiatives and to monitor management function. Non-executive or outside directors play an important monitoring role [11] but also are seen to have the provision of resources, information, legitimacy and access to supports from external organizations [12] as they become conduits for information, knowledge and experiences that travel across the active links in the boardroom network [13].

In the scope of the current study, we will look at board interlocks in the context of Finnish game industry with the goal of getting better ecosystem understanding. Here ecosystems are understood as communities that consist of a heterogeneous and continuously evolving set of interconnected actors that co-create value and interdependency for survival [14], [15], [16], [17]. The research frame encourages drawing from both previous studies of SNA in board interlocks as well as studies of SNA in ecosystem exploration.

The previous board interlock studies have concentrated on the impact on company level, whereas ecosystem approach allows for exploring broader level impacts. Hence, our study departs from the assumption that board interlocks have a positive impact on company performance [9], [10], [18]. We explore the existence and role of board interlocks in the game ecosystem, extending the current application of network metrics, more specifically social network metrics, in this process. Even though we do not make an explicit link to measures of company performance, we discuss the role of
board interlock in the growth of the Finnish game industry.

II. BOARD INTERLOCKS AND SNA

The interlocked directorate is seen to establish channels of power [19]. There have been concerns of undue influence through board interlocks (related to old-boy-networks). At the same time, it has been recognized that interlocks are more influential in some situations than others, and some interlock partners are more influential than other interlock partners. Taking also account the availability of alternative information sources, this has been shown to demonstrate that different types of ties have different types of effects [18]. In short, executives service on the board is not always a major channel of influence [1], but can also be a strong asset.

Some studies about higher levels of director interlocks have been shown to have an impact as they can be seen as desirable collusion to increase sector size and to promote international competitiveness [19]. Companies with well-connected boards earn substantially higher future returns compared to rms with the low-connected boards creating a clear link between board networks and performance [9], [10]. There is however a disparity in findings. [20] found that board network connectedness reduces firm value clearly problematic to the findings of [19] and [10]. Subsequently, despite numerous studies on interlocks and their influence, the issue of whether interlocks actually affect the firms involved remains the subject of much debate, as research has produced mixed and contradictory results [18].

At the same time, board members and the companies they are linked to can be seen through the lens of ecosystems, as communities consist of a heterogeneous and continuously evolving set of constituents that are interconnected through a complex, global network of relationships such as board interlocks. These constituents co-create value and interdependencies for survival [14], [15], [16], [17]. Hence, companies are embedded in networks of relationships that not only create the ecosystem but also remarkably affect their potential success in the markets [21]. These complexities related to innovation have increasingly been addressed with the term ecosystem [22]. Addressing ecosystems as networks allows studying their complex relationships, providing means for mapping the ecosystem structure to support its monitoring and management, sometimes addressed as orchestration.

To explore board interlocks and their impacts, the applicability of SNA method to studying corporate interlocks has been directly addressed: Director networks have a specific structure that can be revealed through social network analysis [19], and [19] as a methodology, social network analysis is a robust qualitative tool for mapping and analysing director networks from the readily available data in the public domain. Only with this tool can the connected components of a director or company network be extracted for use in further research. [19]

In SNA analysis, individual directors are usually identified as nodes connected to companies and to other directors and their companies. The SNA metrics of board interlocks behind the visualization are presented on the network level as well as on the level of individual nodes (see Appendix 1). However, we can also note that not all common SNA metrics have been actively used for exploring board interlocks.

A description of the most common metrics [23] is provided as Table II. Though the metrics, their comparisons and their distributions are at the core of SNA, the value of their visualizations is highlighted: visual network analysis allows the investigators to observe emerging structures and patterns, and to share their findings to others [24].

On the level of a specific node, it is seen that the position of the node within the network is key: occupying a favored position means that the board will have better access to information and resources than the board in a less favorable position [12]. The metrics of degree, centrality and betweenness [10] have been used to explain the role of an individual node. On the level of the network as a whole, the mostly studied metric is density, and a positive relationship between board network density and firm performance has been shown. A moderate level of board network density may be beneficial because it facilitates trust and cooperation among executives, but there might also be a dark side of board network density: an excessive board network density may create agency problems and lead to exclusion of outsiders, lack of objectivity in the strategic decision making, and loss of potentially beneficial strategic input from a variety of informants [11]. Appendix 1 shows SNA metrics used as operationalizations to board connectedness. It should be noted that to explain board density and its functions, the term of social capital has been used by [25].

In the context of innovation ecosystems, network analysis has been used to reveal the flow of information, talent, and financial resources through the relationships of leadership individuals and their associated firms [17]. The term of relational capital has been used to explore the power of relationships within the ecosystem, often times with the explanation of potential: the existing relationships are seen as potential for future success as they are the basis for future relationships [26].

The metrics of ecosystems relational capital again include both node level and network level measures. As snapshots their explaining power is presented as limited; however in comparisons as well as longitudinal studies (measuring change) they are seen to provide better insights for decision making [26].

III. FINNISH GAME INDUSTRY

Finnish game industry has been growing dramatically during the past years (2011-2014). Industry turnover has increased from 165 million in 2011 to 1800 million in 2014, whereas about 1200 more jobs have been created
within the same period [27] (See in Table I). In 2014, Finland had about 300 game companies. Therefore, it is no surprise that the expectations for the game industry to save the post-Nokia Finnish economy and its reputation are extremely high in public media, among decision makers and companies themselves. More companies are expected to experience exponential growth and returns following the pathway of superstars of Rovio and Supercell. At the same time, there is recognition of the limited number of new jobs created by this industry in 2015 only four companies have over 100 employees (including Rovio and Supercell) [28].

The game industry is in interesting growth stage as over 50 percent of the existing game companies have been established during last couple of years [29].

During this growth phase, the game industry has gained the trust of Finns and is today regarded as respectful and seriously taken business attracting foreign investments [29]. Accordingly, new public initiatives have been launched to support the development of the ecosystem around the game industry which cannot only be categorized as entertainment but games increasingly also extend to other sectors like health, well-being and education. This rapid growth of the sector and the nature of innovation environment, with rapid product and company life cycles, have created misunderstanding between the quickly moving game companies and, maybe a little, stagnant innovation policy actors. Yet, one of the most influential actors Tekes Finnish Funding agency for Innovation has showed its commitment by investing 60 million in game sector since 1998 [30].

Certainly, the access to Tekes funding as well as other funding is seen as one of the crucial elements of the success; another one is the fact that Nokia was an early platform and buyer for mobile games, creating a long tradition of digital games [31]. The value chains extended to several sectors and many current game industry employees has a Nokia background given that it was the biggest ICT employee in Finland for years.

A third cornerstone of the success of Finnish game industry often described inside ecosystem is the open sharing and networking which is materialized for instance in monthly get-together breakfasts among game industry CEOs. Many actors describe informality and openness as exceptional characteristics observed hardly in any other ecosystem. One of the advantages of small country, like Finland, is that basis for this openness was built already in early 1990s when gamers gathered in Assembly demoscene to develop and play games. Today, Finland locates several regional game clusters which are connected to as one coherent collaborative Finnish game industry, and everyone still knows everyone.

### IV. Methods and Data

The paper departs from the well-established framework of social embeddedness and its impact to economic activity [32], [33], [34], as well as the findings on performance impacts board member connectedness has on companies [9], [10]. SNA analysis is based on mathematical algorithms that calculate characteristics of actors (or nodes) of the network as well as the characteristics of the network itself, as a whole. This differentiation is important because network dynamics at each level, although related, are also distinct [35]. Accordingly, some assumptions could be made about the SNA metrics in this context, both on the individual firm level as well as on the network level as a whole:

- In the individual firm level, degree and betweenness metrics would be higher, as companies are interconnected.
- In the network level, the density would be significant because a positive relationship between board network density and firm performance has been shown [11]. At the same time, board interlocks would not be completely connected but would consist of a large number of components, a larger component and many smaller ones [19].

In addition to quantitative approach with the metrics, we also apply a more qualitative approach, which has been used toward shared understanding and vision in the ecosystem, a requirement for managing and orchestrating it. Using SNA metrics, preferably based on multiple datasets and/or their combinations, sense making and storytelling are conducted with cyclic and interactive phases where representations are instantiated for shared understanding [26]. Though the results of this study are snap-shot type, and hence do not provide insights for any changes in neither actor/node level nor network/ecosystem level, we see that the value of qualitative narrative in getting toward ecosystem understanding in this context is beneficial.

For mapping and analysing director networks from the readily available data in the public domain [19], we were guided by the previous studies with the assumption that the social networks of board interlocks within an industry play a role. Hence, for this study we relied on one dataset depicting the listing of the company board members.

The data about board members was provided by Suomen Asiakastieto Oy. Suomen Asiakastieto Oy maintains a proprietary company information database, which contains up-to-date data on Finnish companies and their key individuals. It draws their raw data from public and private sources. The game industry data was ordered from Suomen Asiakastieto Oy by providing a listing of companies deemed as Finnish game companies. The listing was based on information

<table>
<thead>
<tr>
<th>Year</th>
<th>Turnover</th>
<th>Number of employees</th>
<th>New companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>1800</td>
<td>2400</td>
<td>44</td>
</tr>
<tr>
<td>2013</td>
<td>900</td>
<td>2200</td>
<td>49</td>
</tr>
<tr>
<td>2012</td>
<td>250</td>
<td>1800</td>
<td>55</td>
</tr>
<tr>
<td>2011</td>
<td>165</td>
<td>1264</td>
<td>31</td>
</tr>
</tbody>
</table>
provided by Neogames Finland, a member-based non-profit game industry organization. The data provided by Neogames was supplemented by the authors to increase the coverage of the data. Suomen Asiakastieto Oy was asked to deliver details on all key individuals for the companies in the list. In addition, data was asked about additional affiliations of the key individuals of the game industry (their links to other companies).

The data used was captured in two cycles. The first version of the analysis was made based on data ordered in November 2013 and the second cycle of data was ordered in May 2015. In total, the first cycle of data was requested on 199 companies. With the update, the second cycle requested data on additional 96 companies. In this paper, we have merged the two cycles of data.

The data was pre-processed toward network data format where a vertex is either a unique key individual or company and an edge is a connection between a key individual vertex and organization. The edges were defined as directed from key individuals to organizations. Hence, the resulting network is a bipartite network, showing the connections between the individual board members and their companies. Finally, the bipartite network was projected to a one-mode network of company connections.

Established social network analysis metrics was used to describe the structure of board member networks of the Finnish game industry. Thereafter, we used the visualization to create a qualitative narrative for the network. Pre-processing for the network data was conducted using Python and Excel. Visualization and graph metrics were calculated using Gephi.

V. RESULTS

The data contains 151 game companies and 296 key individuals connected to the game companies. Hence, data from about half of the game companies were available for this exploration of the role of board interlock. This most likely reflects also the maturity of the sector and reporting practices in Finland: for the very new companies, this data does not exist yet in the public data sources.

A. SNA metrics

The resulting network in Figure 1 was created from 1267 vertices (nodes) and 1230 edges between the vertices. Notably, 820 nodes in the network are companies outside the game industry. The SNA metrics of the network are presented in Table III. The graph density of the network is low, 0.001. This is partly due to how the graph has been structured. As organizations cant have edges between them, the network will never reach the full graph density value of one – a complete graph in which every pair of distinct vertices is connected by a pair of unique edges, one in each direction. Even with this precondition created by the research set-up, the extremely low graph density shows the scarcity of board networks.

The average degree of a node is 0.971 and as the highest degree is 23, we expect a significant deviation in the degree values of vertices. The high deviation is partly explained by some persons having a large number of board memberships, and partly by organizations having a relatively small board. Twenty key individuals have an affiliation to 10 or more companies. Within game and other companies the maximum degree is 5.

Due to the low graph density and average degree, further calculations to establish sub-networks or centrality measures are redundant. The game industry does not draw from any particular latent network structure at a board level raising significant questions on the impact of board members, board networks and interlocks.

The bipartite network was transformed to a one-mode projection to further evaluate the metrics used by [22]. Figure 2 shows the projection and although there are more interlocks the network remains sparse. The SNA metrics for the one-mode projection are in Table IV.

We used the visualization in Figure 1 to create a qualitative narrative to describe the network structure. Figure 1 shows the anonymized network of organizations and key individuals. Green nodes are key individuals, blue nodes are game companies and red nodes are other than game companies where the key individuals have a board member role. The node size represents the degree of a node, scaled from 1 to maximum degree of 23. The network has limited connections with average path length being one. The short path length is clearly visible in Figure 1, where the whole network is built from isolates.

The center of the graph forms small sub-networks with a few central key individuals. Within these, the role of key individuals with degrees over 10 and the role of companies other than game are central to any sub-network existing. The nodes far from the center are mostly created among one game company and its board.

B. Qualitative narrative for sense-making and storytelling

The insights from SNA metrics were amplified with the network visualization, which act as more than a pretty picture enabling human insight and foresight. Combined, they enable hypothesizing on a qualitative narrative for the network toward sensemaking and storytelling, and accordingly, help to address the assumptions of this study.

The results of board interlocks of Finnish game industry did not support the individual level (degree and betweenness metrics) nor the network level (density and clustering/large component) SNA assumptions. The degrees of nodes have large variance, but in general are rather low. The density is very low and only a few large clusters can be identified. Illustrated by Figure 3 the network has 10 clusters with 35 or more nodes embedded to the subnetwork whereas the
majority of cluster have 5 or less nodes embedded, this can be also seen in the network visualization, which shows that this network of board interlocks does not clearly manifest itself as an interconnected network.

The snapshot-type visualization of patterns and structures of the network does allow for qualitative narrative. The network can be seen to present two typical structures; entrepreneurial and investor-driven networks. Entrepreneurial substructures are far from the network center and constructed from a game company, a non-game company and most commonly their founder/owner. We observed that in most cases, even substructures far from the center are created by two organizations and one or two key individuals. Interestingly, key individuals have multiple board member positions often outside the game industry, suggesting that the individuals entrepreneurial activity extends beyond the game industry.
Table II
SNA METRICS OF ECOSYSTEMS – A NON EXHAUSTIVE LIST.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node</td>
<td></td>
</tr>
<tr>
<td>Betweenness Centrality</td>
<td></td>
</tr>
<tr>
<td>Clustering Coefficient</td>
<td></td>
</tr>
<tr>
<td>Network</td>
<td></td>
</tr>
<tr>
<td>Degree Distribution</td>
<td></td>
</tr>
<tr>
<td>Diameter</td>
<td></td>
</tr>
<tr>
<td>Clustering</td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td></td>
</tr>
<tr>
<td>Main Component size and proportion</td>
<td></td>
</tr>
<tr>
<td>Rate of Edge growth</td>
<td></td>
</tr>
</tbody>
</table>

Table III
SNA METRICS FOR THE BIPARTITE NETWORK IN FIGURE 1.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree</td>
<td>0.971</td>
</tr>
<tr>
<td>Cluster Coefficient</td>
<td>0</td>
</tr>
<tr>
<td>Diameter</td>
<td>1</td>
</tr>
<tr>
<td>Clustering</td>
<td>143 communities</td>
</tr>
<tr>
<td>Density</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table IV
SNA METRICS FOR THE ONE-MODE PROJECTION OF THE NETWORK IN FIGURE 2.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree</td>
<td>6.7964</td>
</tr>
<tr>
<td>Cluster Coefficient</td>
<td>0.085</td>
</tr>
<tr>
<td>Diameter</td>
<td>10</td>
</tr>
<tr>
<td>Clustering</td>
<td>18 communities</td>
</tr>
<tr>
<td>Density</td>
<td>0.007</td>
</tr>
</tbody>
</table>

We can argue that the role of the board key individual member is to meet formal requirements and it has no specific corporate strategy driven role.

The investor-driven substructures are created around key individuals with a high degree value. These are, in most cases, networks where the key individual has a large number of connections to companies other than game industry. In most cases, key individuals with a high degree value are formally connected to an organization identified as a venture capital actor. The high degree value key individuals in the center of the network have a large number of nongame industry connections, but most often only one game company link. This suggests that these actors are investors having one game organization in their investment portfolio. The network does not show key individuals with strong portfolios of game companies (three or more).

Finally the structure of the network can be described with including an extremely limited amount of networks that extend multiple game companies. In most cases, a clear substructure is formed with one or at maximum two game companies with one key individuals connecting the two companies.

VI. DISCUSSION

Literature has shown that specifically the top-level formal relationships create significant positive externalities [36]. Active and tightly formed top-level networks have been seen to promote overall sector growth and to create capabilities towards internalization. Many studies about higher levels of director interlocks have been shown to have an impact as they can be seen as desirable collusion to increase sector size and to promote international competitiveness [19], and these studies have also introduced the method of SNA to explain the role of board networks. In addition, the importance of relationships and interconnectedness has been addressed when using SNA to explore ecosystems in this paper game industry in Finland.

Accordingly, we assumed to board networks or interlocks to be specifically important to sectors such as the game industry, which is a growing and very successful in Finland. It is mainly formed by start-up companies that actively seek funding and compete on the global market, and hence can be seen as need flows of knowledge, experience, talent and money that have been identified as flows provided by board members. However, the sparse formal networks are common in new emerging sector which has large amount of start-ups who are just in early phases of their business and are on their first investment round. This also partly explains the absence of links to global game ecosystem as foreign investors were not very prominent in the data. We expect these links to grow as the industry matures and foreign investments increase. For this reason, ecosystem is foreseen to globalise also on formal level in future. Currently, the links to global ecosystem are formed via informal relationships, given that open sharing and informal networking are strong characteristics in the field.

Our analysis looked at formal board member networks. With the assumptions we thought that the actor or node level metrics (degree and betweenness centrality) would be high as would be the network level metrics (density and clustering/ component). These assumptions were not supported by the resulting SNA metrics and visualizations based on those.
A. Theoretical and managerial implications

This paper raises significant questions on the impact of board members, board networks and interlocks. We can question if and to which extend the board member interlocks create a social network for resource exchange, which is the major contribution of this paper. We contribute by extending the context from large firms into smaller firms, which have not been traditionally addressed in board interlock studies [11]. Furthermore, going beyond the company level impact and looking at industry impact, which was done with ecosystem metrics, also adds to our contribution.

Based on our results and their sense making and storytelling, we can provide some support for decision making in the context of Finnish game industry. We strongly encourage acknowledging the roles of multiple networks on different levels of the ecosystem, from individual relationships to
team connections and company connections. Hence, we want to emphasize (a) going beyond formal relationships such as boards, and that (b) the fact that game ecosystem is not a stand-alone sector, but should have important relationships with advertising, entertainment, networking, video etc., and looking at those resource flows could be beneficial for further understanding the ecosystem. There are some challenges though in building the links to other sectors, as we have observed that Finnish game industry is fairly closed what comes to inter-industry collaboration. Openness seems not to extend outside game ecosystem. A practical recommendation for both of the above is using ecosystem mapping, which we recommend for both individuals, game companies as well as those concentrating on the game ecosystem level orchestration and guidance.
B. Limitations and suggestions for further research

Our analysis has its limitations. First of all, we looked at formal board member networks with looking at both connections between board members themselves as well as between the companies. Traditionally board interlock studies have concentrated only on the relationships between companies. Secondly, we based our study on a single available public/private data source. Relying on a single data source is a limitation per se; however, it is the normal way of analyzing board interlocks. Thirdly, our analysis was a snapshot, which most likely limits the explaining power of SNA metrics. Our fourth limitation is linked to the first one, as we concentrated only on formal networks. Prior research has shown that executives service on the board is not always a major channel of influence [1] and that the correlation between board interlocks and company performance has been questioned [18]. Furthermore, in addition to formal, the role of informal networks has long been acknowledged and those (breakfast meetings and demo-community participation) were explicitly mentioned in the context of the Finnish game industry. In addition, the Finnish game industry has only recently (in 2013-2014) received larger foreign investments which is likely to show in board level data later. Besides, the phenomenon of professional board member is not prominent in the Finnish game sector that shows in sparse networks.

As a response to the limitations, we provide some suggestions for further research. To better explore the ecosystems beyond its formal structures, we call for complementing the formal data with informal data, referring to the social media data available on the informal connections between boards and companies in the ecosystem. Using multiple datasets and even their combinations has been useful in the context of innovation ecosystems research [26]. Furthermore, as SNA lends itself nicely for comparisons, a natural follow-up study is suggested so that changes in SNA metrics can be observed in the context of Finnish game industry. Also, studies comparing different industries and/or different phases of sectors would be interesting.

VII. Conclusion

In this paper, we looked at the role of board interlocks as the tool of inter-organizational flows needed for innovation and growth of the companies and the ecosystem. To explain the role of social networks, namely the board interlocks or networks, within an industry, we applied prior research from board interlock SNA and wider innovation ecosystem research into the case context of Finnish game industry. Finnish game industry has been in the 2010s very successful, lots of national hope is attached to it and its further success.

Using the individual node (actor) level metrics and network level metrics from prior research, we did not find the results that we expected based on the prior study: the resulting board network was not interconnected. Hence, the role of these formal board relationships can be seen as limited in the context of Finnish game ecosystem. Further research is encouraged to extend the board interlock studies beyond formal networks, single datasets, possibly also with novel measures of company and sector performance.

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