

# **Orchestrator Bypass: The Emergence of Non-orchestrated Collaboration in the Danish News Ecosystem**

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**Abstract:** Orchestration-enabled collaboration is a frequent trait of digital ecosystems. For instance, in the news ecosystem, a common practice involves producing articles that reference content published by news agencies and other organizations. However, it remains incompletely understood how such collaborative practices shift when the ecosystem orchestrator encounters a crisis, and what structural implications this has for the ecosystem’s evolution. We suggest that ecosystem complementors shift towards non-orchestrated collaboration and propose that such crises may precipitate what we term as “orchestrator bypass”: the move towards direct collaboration among complementors, circumventing the central orchestrating firm within the ecosystem. Utilizing a dataset of 31 million articles and adopting a mixed-method approach, this paper underscores the empirical relevance of the “orchestrator bypass” effect by tracking citation patterns in the Danish news ecosystem from 2000-2021. Specifically, the significant crisis endured by the key Danish news agency between 2008-2015 provides us with an opportunity to investigate whether, and how, orchestrated collaboration was replaced by non-orchestrated collaboration among complementors, and the repercussions of these changes on the ecosystem’s structure as manifested in citation patterns. We document how the crisis resulted in a higher reliance on direct citations between complementors, resulting in a more decentralized ecosystem structure, thus illuminating the adaptiveness of digital news ecosystems during near-failures of ecosystem orchestrators.

**Keywords:** ecosystems, status, networks, orchestration, news media

## INTRODUCTION

Collaboration among rival firms is recognized as a characteristic of many business ecosystems, with different roles shaping participant activities (Hannah & Eisenhardt, 2018; Jacobides, Cennamo, & Gawer, 2018; Kapoor, 2013). Typically, a central firm orchestrates the ecosystem by ensuring coordination and collaboration among ecosystem participants, while establishing the basic principles for both collaboration and competition (Adner, 2017). Complementors assume the role of enhancing product value for the end consumer, often through bundling or reconfiguration strategies (Shipilov & Gawer, 2020), while adhering to the orchestrated guidelines. The motivation for participation in such ecosystems generally stems from the prospect of “win-win” collaborations that are believed to yield net benefits for all participants involved, such as collective innovation, safeguarding against changing technological environments, or augmented value propositions through complementarity (Adner & Kapoor, 2010).

Consider, for example, the news ecosystem – the network comprising national and local newspapers, news agencies, specialized publishers, and news media firms. In this context, citations among organizations – where a news agency or competitor is credited as the information source in an article – exemplify such “win-win” collaborations. This practice allows larger organizations to amplify the visibility of their stories, while smaller organizations gain the ability to report on stories which their resources would otherwise not allow them to trace and research. In essence, the citation practice fosters inter-organizational complementarity: backend information exchange coexists with frontend competition for reader attention. Furthermore, since citations can be seen as a signal of conferred status, they are crucial in reflecting the social structure of the news ecosystem.

However, how changes to orchestration arrangements in digital ecosystems (re)shape the ecosystem's structure and evolution over time remains largely unexplored. Specifically, while the benefits and presence of the orchestrator role within ecosystems are well-documented, our understanding of how complementors and the ecosystem adapt when the central firm faces pressures and potential collapse is limited. As collaboration largely relies on the central orchestrating firm, predicting the changes of collaborative arrangements and structures is difficult. Relevant prior work on ecosystem evolution has focused on the impact of disrupters (Ansari, Garud, & Kumaraswamy, 2016; Snihur, Thomas, & Burgelman, 2018; Teng & Jacobides, 2020), the orchestrator's definition and enforcement of rules and norms within ecosystems (Daymond, Knight, Rumyantseva, & Maguire, 2023; Kretschmer, Leiponen, Schilling, & Vasudeva, 2022; Rietveld & Schilling, 2021; Rietveld, Schilling, & Bellavitis, 2019), the interplay between competition and collaboration (Gnyawali, He, & Madhavan, 2006; Hannah & Eisenhardt, 2018; Hoffmann, Lavie, Reuer, & Shipilov, 2018), and how ecosystem conflict can induce changes in collaborative behavior (Jones, Leiponen, & Vasudeva, 2021). While these studies offer valuable insights into the orchestration, disruption, and evolution of ecosystems, robust large sample evidence tracing ecosystem evolution as complementors adapt to uncertainty regarding an orchestrating central firm is absent. Investigating these dynamics is crucial, as it remains unclear whether disruptions to an ecosystem's central firm, and the potential shift to non-orchestrated collaboration as complementors adapt, may detrimentally impact the performance, innovation, and survivability of the ecosystem. We argue that one potential outcome of such scenarios is the emergence of "orchestrator bypass": direct collaboration among complementors that circumvents the orchestrator, ensuring that ecosystem activities persist despite the central firm's looming failure. This perspective is currently

underrepresented in the ecosystem literature, which is typically focused on the orchestrator's role.

This paper documents the empirical relevance of orchestrator bypass through an exploratory large- $N$  two-decade longitudinal analysis, which utilizes a crisis experienced by the Danish news agency Ritzau – a central firm with an orchestrating role in a sub-ecosystem within the Danish news ecosystem – to document the emergence of orchestrator bypass and its impact on ecosystem evolution over time. Summarized, the crisis for Ritzau involved owners leaving the jointly owned agency and launching competing agencies, putting the survival and authority of the central firm into question. Like Ritzau, many of the leading news agencies (e.g., Associated Press, Agence France-Presse, Deutsche Presse-Agentur) are partly owned and/or governed by competing news outlets and are central firms in the news media ecosystems. However, for analytical purposes, the Danish context is particularly interesting, as it allows for investigating complementors' behavior and the ecosystem structure during uncertainty regarding the authority and survival of the ecosystem's central firm. Moreover, because almost one in five articles produced by the Danish news ecosystem involves a citation to Ritzau, the crisis threatened the productivity of the ecosystem and potentially the survival of individual news organizations. We, therefore, expect that complementors – the news organizations – would adapt to this uncertainty.

The news ecosystem further provides a meaningful context in which to investigate ecosystem evolution as we can 1) trace the flows of information between ecosystem participants through citations, and 2) investigate the impact of changing information flows on ecosystem structure.

We formulate the concept of orchestrator bypass and ask *whether uncertainty regarding the central firm in the ecosystem has implications for collaboration arrangements and ecosystem structure.*

This is investigated by combining ideas from the status-based model of market competition (Podolny, 1993, 2001; Podolny & Phillips, 1996; Stuart, Hoang, & Hybels, 1999) with the perspectives found in the ecosystem literature (Adner, 2017; Jacobides et al., 2018). Specifically, the focus is on news organizations' citation-based production strategies, where news articles are produced by citing news agencies or competing news organizations. We argue that a biproduct of citation is the generation of status for the cited organization. Thus, in a status-based model of market competition, being citable is a way to further the status position of a firm in a digital ecosystem structure.

We use a mixed methods research design and utilize triangulation between methods to validate results. This includes network analysis of 6.3 million citations among 31 million news articles, qualitative interviews, and archival data. We exploit an event that allows us to trace complementors' behavior before, during, and after uncertainty arises regarding the central firm with an orchestrating function. Our analysis shows that the crisis surrounding the Danish national news agency, Ritzau, from 2008-2015 led to the rise of direct citations between competing complementors, which temporarily resulted in a more widely connected network and a less inequal citation distribution across the network of news organizations in the ecosystem.

From these results, we highlight that uncertainties regarding the survival and orchestrating authority of the ecosystem's central firm might lead to 1) a temporary decentralization of the status order of actors in the ecosystem, and 2) the rise of non-orchestrated collaboration between complementors that bypass the orchestrator in digital ecosystems. In

contrast to orchestrated collaboration, non-orchestrated coordination is a nonformalized and uncoordinated reality that is silently agreed upon between complementors which can emerge from uncertainty about the ecosystem orchestrator's survival and authority. Such temporary shifts toward uncoordinated and non-orchestrated collaboration during a crisis surrounding the ecosystem orchestrator have not, to the best of our knowledge, been highlighted and shown in extant literature on ecosystem evolution.

These findings highlight the robustness and adaptability of digital ecosystems, as non-orchestrated collaboration and orchestrator bypass might act as temporary answers to uncertainty regarding the central firm in the ecosystem. This durability is an important feature, given the democratic importance of some digital ecosystems, e.g., the news ecosystem.

## **ORCHESTRATED AND NON-ORCHESTRATED COLLABORATION IN DIGITAL NEWS ECOSYSTEMS**

This paper investigates the Danish news ecosystem as an example of a digital ecosystem, which consists of affiliated and interdependent organizations (Adner, 2017), and is defined by high levels of orchestrated collaboration and coordination between ecosystem participants. The news sector has long been and continues to be, integral to contemporary democracies, often being described as the Fourth Estate with the responsibility for enlightening and informing the public on important societal and political matters. With the emergence of the Internet came the demand for digital news and the change in distribution infrastructure for news items has led to a change in the scarce resource that is competed for: it is now attention with the aim of generating 'clicks' and advertisement exposure, and less so the previously valuable commodity of information (Meyer, Kerkhof, Cennamo, & Kretschmer, 2022). This understanding is often referred to as the

attention economy (Davenport & Beck, 2001; Simon, 1956). The move to platform-based news distribution has also introduced the importance of time and immediate reporting, as attention spans have been shown to shorten (Lorenz-Spreen, Mønsted, Hövel, & Lehmann, 2019), which incentivizes increasing the output of news products to gain momentary visibility and reader attention.

Usually, businesses try to remain exclusivity over their products by not allowing competitors to produce too similar goods, e.g., by obtaining patents or securing copyrights. Thus, when a news organization cites a competing news organization in their article, or when they copy (parts of) a competitor's news story and re-distribute it as their own, it would traditionally be interpreted as the original producers losing out on profit prospects due to the competitors 'stealing' their products. However, the incentives for maintaining exclusivity might be less applicable in digital ecosystems such as digital news ecosystems, as the product – a news article – has only a somewhat momentary value for the original producer: while it is still 'newsworthy' (Schultz, 2007). Thus, when a competitor later publishes a similar story, its informational value has diminished, and the imitation is less costly. Further, it is potentially converted to status due to interorganizational endorsement, if other organizations imitate the product and by doing so, implicitly indicate that the cited news organization has produced a story that is of satisfactory quality and is interesting enough to be re-distributed (Stuart et al., 1999). Therefore, imitation from competitors is not necessarily detrimental to an organization's success and position in the ecosystem but might instead drive it toward a central status position in the ecosystem (Han, 1994). Thus, when changes in citation practices occur, changes in an ecosystem's status order are probable. Inspired by the embeddedness literature (Granovetter, 1985; Uzzi, 1997), we understand such changes in the social status order as an expression of changes in ecosystem

structure. These changes in status positions may have a profound impact when they take place in digital ecosystems that possess democratic importance because the re-structuring might influence the basis on which vital information is passed to citizens.

News agencies have long played a key role in the news ecosystems, delivering the information on which many news stories are based. Besides providing this base product, news agencies also take on the roles as central firms with orchestrating responsibilities, e.g., aligning coordination and collaboration practices by having set precedents for how information may be re-distributed and re-purposed if citation of agency takes place. For example, Ritzau has through contracts with complementors established how the firm is to be cited when complementors build on its products. Such news agencies are often organized as formal orchestration arrangements, as competing news organizations jointly own and govern a shared news agency that becomes a meta-organization in the ecosystem (Kretschmer et al., 2022).

However, the advent of digitalization and uncertainty regarding the survival of the central orchestrating firm, such as the news agency Ritzau, might drive a move toward what we call non-orchestrated collaboration. Non-orchestrated collaboration describes collaboration arrangements that are 1) emergent, meaning that they arise due to uncertainty about the survival of the ecosystem's central firm, and 2) non-formalized and non-institutionalized, meaning that they are not written down or formalized in for example contracts nor are they established by any singular central actor. The citation practices between complementors we observe in the news ecosystem fit the parameters of this type of collaboration. It is a non-formalized practice, that is not written down anywhere, but is engrained in the *doxa* in the journalistic field, i.e., their implicit playing rules (Bourdieu, 1990) by way of their professions' norms and ideals (Abbott, 1988). This is in part made possible by digitalization, as the lowered transaction and search costs



enable organizations to monitor their opponents and cite their work at no cost or need for orchestrated collaboration. As such, in the specific case of news ecosystems, when non-orchestrated collaboration is expressed through citations, it entails that actors accept competitors borrowing their stories and information if citation of the original source takes place. The logic behind this is that the originator is paid for their story in the commodity of endorsement and status through such citations (Stuart et al., 1999).

When non-orchestrated collaboration emerges during uncertainty about the survival of the ecosystem's central firm, it may lead to what we term *orchestrator bypass*. With this we mean the cases, where complementors collaborate directly by circumventing the orchestrator that previously set standards and alignment for collaboration activities. While a loss of control and authority for the central firm, the ability to bypass the orchestrator in uncertain times allows complementors to conduct business (close to) as usual, and for the ecosystem to survive the crisis. The turn to direct ties between complementors means that the advantageous broker position (Burt, 1980) of the central firm diminishes, and in turn the collaborative network becomes more decentralized. The orchestrator bypass is not necessarily a permanent state but may be substituted by a return to orchestrated collaboration as the crisis is resolved, or when a new firm takes on the central role as an orchestrator.

We will test empirically whether such non-orchestrated collaboration arose during the Ritzau crisis, whether the orchestrator bypass emerges during such shifts, and the implications it has for ecosystem structure.

We expect that the uncertainty regarding Ritzau as the central firm leads to orchestrated collaboration being replaced by non-orchestrated collaboration, where direct collaboration between complementors bypass the central firm,, as indicated by Hypothesis 1.

*Hypothesis 1: During uncertainty regarding orchestrated collaboration, ecosystem complementors collaborate directly, and bypass the central firm through non-orchestrated collaboration.*

In the sociology of science, citations from competitors are often argued to drive centralizations of influence on the hands of a few actors. Scholars have argued based on citation analyses that successful scholars are characterized by receiving many citations and being influential in their field, i.e., other people rely on their work and use it or build on it for their own gain (Allison & Stewart, 1974; Azoulay et al., 2014; Blume & Sinclair, 1973; Cole & Cole, 1973; Merton, 1968; Nielsen & Andersen, 2021). Cited scientists in such studies are not described as ‘losing market shares’ after they have published their work and it is imitated by others – rather, it is seen as leading to recognition and status. In some cases, achieving a high status by way of citation can become a reinforcing mechanism, where those cited the most increasingly obtain more citations (Azoulay et al., 2014; Nielsen & Andersen, 2021), and thus, more status. This is often referred to as the Matthew effect (Merton, 1968). Like scientists, journalists chase citations from competitors, as it is seen as an indication of professional recognition, and thus a pathway to increased status and reputation (Hartley, 2013; Hartley & Ellersgaard, 2013; Schultz, 2007). Thus, the *doxa* (Bourdieu, 1990: 68) in both ecosystems suggest citations from competitors are valuable commodities worth striving for and understood as indications of achievement and performance.

Based on the evident link between citations and status, behavioral changes in citation practices might aggregate into structural changes at the network level as reflected by the status order. To help describe structural changes in ecosystems due to uncertainty regarding the survival of the ecosystem’s central firm and shifts in collaboration practices, we define two processes related to ecosystem structure: centralization and decentralization. With

*decentralization*, we mean the process where a higher number of actors in a network come to accumulate relatively more status, and previously central actors obtain relatively more peripheral positions – and vice versa for the process of *centralization*.

Previous literature suggests that industry “structure-loosening” events can have the effect of temporarily decreasing network centralization (Madhavan, Koka, & Prescott, 1998), i.e., what we call decentralization. Such events provide opportunities for less peripheral actors to improve their centrality: in this context, their position in the status order. As previously stated, changes in the status order of the ecosystem are interpreted as changes to the ecosystem structure. We expect the structure of the news ecosystem to change during uncertainty regarding the central firm’s survival because of the emergence of orchestrator bypass, which empirically corresponds to more direct ties between complementors in the network structure that circumvent the central orchestrator and a less concentrated distribution of citations in the ecosystem.

*Hypothesis 2: Due to orchestrator bypass, the ecosystem structure will change, become more decentralized, and status will be more equally dispersed.*

While we expect a more decentralized structure due to orchestrator bypass, we do not expect the reshuffled status order to be randomly ordered or turned entirely on its head. Rather, as the highest-status actor in the network – the central orchestrator loses centrality, we expect other already-established high-status actors to gain more from the process of decentralization than lower-status actors (Podolny, 1994). We expect this due to the informational nature of news ecosystems, where the quality and validity of information might be assessed by status positions and signals (Uzzi, 1996). Therefore, if a news organization has established a good reputation and is perceived as a high status actor both within and beyond its direct ties, it is more likely to be chosen as a tie from other organizations (Chung, Singh, & Lee, 2000; Gulati & Gargiulo, 1999; Han, 1994; Podolny, 1993). Empirically, we expect this to be observable by high-status news

organizations becoming more central, as they receive more citations from competitors compared to organizations in lower-status positions, despite an overall decentralization process.

*Hypothesis 3: A decentralization of the ecosystem structure favors mainly pre-established high-status complementors that become more central.*

The three hypotheses will be empirically investigated within the context of the Danish news ecosystem. However, they might be applicable in other contexts than the Danish news ecosystem if they also involve orchestrated collaboration from a central firm and its survival falls under uncertainty.

### **CONTEXT: THE RITZAU CRISIS**

This paper utilizes a crisis that was experienced by the Danish national news agency, Ritzau, between 2008-2015, to investigate how complementors adapt to uncertainty regarding the survival of the ecosystem's central firm. The impact that a crisis surrounding the near-monopolistic news agency might have in a news ecosystem is evident in the fact that Ritzau alone encompasses 72 percent of all 6.3 million citations over the 21-year timespan of our data. The loss of such a central firm would intuitively lead to a large negative effect on the network as a whole (Uzzi, 1997). To contextualize our analysis of the events surrounding the crisis, we provide a brief timeline of the crisis experienced by Ritzau as it unfolds in the collected archival data.

Ritzau was formed in 1866 by Erik Nicolai Ritzau. Following censorship during WW2, the Ritzau family agreed to sell ownership of the company to the shared Danish press. With the sale, competing Danish newspaper organizations came to collaborate on a shared news agency in which they all had an interest. All owners were given a seat on the board of Ritzau which became registered as a partnership between firms ("interessantskab" (I/S) in Danish). Due to

choosing a governance model for the company with deep roots in Danish traditions, the cooperative (“brugsforening”), purchase obligations for owners were set in place. Because of the joint ownership and governance of the central news agency, Ritzau can be thought of as a “meta-organization” in the Danish news ecosystem (Kretschmer et al., 2022), where complementors jointly use the firm’s board to formally align coordination and collaboration practices. As is the case for other big national agencies in many other countries, Ritzau has long been, and still is, a much-renowned brand, and has an instrumental role in the Danish news ecosystem’s information flows.

However, in 2006, the strong position of Ritzau starts to diminish as new players enter the market and otherwise loyal customers leave the partnership, e.g. TV2 and DR. However, in 2007, DR and TV2 re-subscribes to Ritzau, and DR becomes co-owner of Ritzau.

The period we call the Ritzau crisis begins in 2008, when the Global Financial Crisis puts economic pressure on Danish news companies, including Ritzau. Alongside new entrants in the news agency business, critics claim that Ritzau’s reporting is boring, “heavy and solemn” and unfit for new formats (Journalisten.dk, 2009). In 2010, Ritzau workers go on strike twice that year.

The biggest hit to Ritzau’s dominant position takes place in 2011, which reinforces the “structure-loosening” (Madhavan et al., 1998) forces of the event. Berlingske Media, one of Denmark’s biggest media houses, withdraws from the Ritzau partnership and establishes its own competitive news agency, Berlingske Nyhedsbureau (BNB), in December 2011. Regional newspapers Bornholms Tidende and JyskeVestkysten decide to leave the partnership shortly thereafter. TV2 and Børsen consider leaving but end up staying in the cooperative. Ritzau ends

2011 with a 17.3 million DKK deficit and its CEO warns about financial cuts in 2012 amounting to 12 million DKK.

Things are looking dire for Ritzau in 2012. In the face of the dubbed “total war in the telegram business”, Ritzau is transformed from a partnership into a stock-based corporation (“aktieselskab (A/S)” in Danish) to become commercially competitive in uncertain times. Ritzau’s Chairman of the board publicly states that “It is an either/or. Ritzau does not survive with its current structure [partnership]” (Mediawatch, 2011). Further, if the transformation would not go through: “Then I do not believe that Ritzau would have a very long future” (Journalisten.dk, 2011). With the transformation, the remaining owners inject new capital into the business.

In 2013, Ritzau needs to cut its budget by 10 % and lays off personnel once again. At the end of 2014 however, Ritzau makes its first profit since the start of the “telegram wars”.

In 2015, Jysk Fynske Medier, Denmark’s third largest media house, leaves Ritzau and makes an agreement with BNB from 2016 onwards. Later that year, however, Berlingske workers go on strike due to planned cutdowns and the intended closing of BNB. Ritzau acquires BNB and its customers from Berlingske Media, who again become customers of Ritzau, albeit without Berlingske Media reentering as a co-owner. The “total war in the telegram business” ends with Ritzau as the victor.

## **DATA AND METHODS**

To investigate our hypotheses, we use a mixed methods research design, building on qualitative interviews, archival data, and citation network analysis. Our hypotheses require inquiry at two analytical levels. On one hand, we propose that collaboration behavior changes

under uncertainty around the central firm in the ecosystem. We operationalize such behavioral adaptations as changes in citation practices during the Ritzau crisis by individual news organizations. Insight into the behavioral changes is facilitated with our data collection and processing procedures. On the other hand, we propose that the structure of the ecosystem changes in response to aggregated changes in collaboration behavior. This is measured via the structural properties of annual citation networks and the PageRank algorithm.

### **Sampling News Media Organizations**

The mapping of behavioral changes and status positions over time required a longitudinal dataset, and to obtain a robust and precise account of the ecosystem over time the dataset also had to be comprehensive. This required a delineation of which news organizations should be included in the analysis, as well as a systematic data collection process.

The context of the analysis was the Danish news media ecosystem, comprising organizations that provide news coverage on the web either on a local/regional, or national scale in Denmark. Concretely, a list of all news organizations registered in the media archive from Danish media surveillance company Infomedia was downloaded, and each news organization in the list ( $N = 1,210$ ) was manually coded as included/not included in the sample. Each website was visited manually, and its characteristics were outlined based on frontpage articles and information in the “About” sections of the webpages. The criteria for inclusion of a source were that it 1) provided either locally/regionally/nationally oriented news daily in Denmark, 2) was not a magazine or reporting opinion-pieces only (e.g., Euroman), and 3) used Danish as its main language. Following this procedure, the sample for the analysis consisted of a total of 362 news

organizations, of which 305 were marked as local/regional in their coverage (e.g., Aabybroposten.dk), and 78 coded as nationally oriented (e.g., Politiken.dk)<sup>1</sup>.

### **Collecting Citation Data**

As mentioned, our measure of behavioral changes in collaboration is operationalized as citations in published news articles, as such allows us to both link behavioral change to specific points in time, and further, they can be aggregated to the network level. Citations were defined as mentions/links to competing news organizations in the body text of a news article alongside a context verb, e.g., "... writes *Berlingske*" (see Appendix B. News agencies mentioned in either the byline or body text of a news article were also included as citations. To carry out a temporal analysis, the counts of total citations to/from all news organizations in the sample per year were needed<sup>2</sup>. However, there is no Web of Science or any similar aggregator that trace citations in the Danish news industry, and the data was not easily accessible. We, therefore, considered alternative approaches to extracting citations from published news articles, while still maintaining a high level of reliability and data quality.

This was achieved by scraping search results from Infomedia's media archive via the Selenium library and Python scripts, which we programmed specifically for the media archive infrastructure. Concretely, we constructed ~1.2 million search strings in Infomedia's IQL language, covering all possible pairs of two news organizations in the sample by each year between 2000 and 2021<sup>3</sup> and fed them to the database. We also extracted the annual article

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<sup>1</sup> The full list of news organizations included in the sample is available in Appendix A.

<sup>2</sup> News agencies ( $n = 23$ ) were also added to the sample for this analysis. However, news agencies can only receive citations in this analysis, and not themselves cite news organizations. This is due to Infomedia's Mediearkiv not containing articles from all news agencies.

<sup>3</sup> For transparency, a randomly selected search string is presented here, which includes a sourcecode (a webpage's alias in Infomedia's database), a potential citation in the bodytext ("ifølge politiken") and the daterange pertaining to the year 2020: sourcecode:4AS AND bodytext:"ifølge politiken" AND publishdate:[2020-01-01..2021-01-01]



counts per organization stored in the media archive. Each search string was fed to the Mediearkiv one by one. After each search string, the total mentions from organization A toward organization B were counted and stored via BeautifulSoup and Regular Expressions. To increase confidence in its accuracy, the data was scraped over three iterations, as data errors were identified in the initial iterations. After the third iteration, the citation counts from the second iteration were reproduced.

Following this procedure, we obtained all citations between the competing news organizations among a total of 31,700,129 articles for the 21-year timeframe. While earlier work has traced citations in news articles via citation network analysis (Spitz & Gertz, 2015; Spitz, Strötgen, & Gertz, 2018), our dataset is to our knowledge the first of its size and temporal span. It should be noted that we are not able to collect the content of news articles and cannot use natural language processing to extract any features from cited news articles with our approach. However, for the purpose of analyzing collaboration behavior and structural changes during the Ritzau crisis, the long temporal span was favored.

In total, 6,347,310 articles contained a minimum of one citation of a competitor or a news agency, amounting to approximately 20 % of all articles. This is likely a conservative estimate. In our data collection, we prioritized high precision over high recall and opted for adding context words to the scraping procedure for citations between competitors to avoid capturing simple mentions in articles that may not always be citations. Further, our list of context words may not be fully comprehensive.

Along with the textual and quantitative data, we conducted eight semi-structured interviews with journalists, editors, and management from a national Danish news agency, local/regional news organizations as well as the biggest national media houses in Denmark. The

aim of the interviews was to get a sense of the journalistic field's *doxa* (Bourdieu, 1990) from the insiders themselves. Further, we inquired about our interpretation of citations as an expression of status through the interviews. The interviews were conducted virtually, recorded, and automatically transcribed in Danish. All interviewees were promised anonymity. Therefore, names, workplaces, and otherwise revealing information has been censored.

When relevant, excerpts from the interviews are included for analysis. Doing so, we 1) provide context for the quantitative results and nuance our interpretations of them, and 2) triangulate our findings and assess ambivalences between the qualitative and quantitative domains, using the interviews as robustness checks and the archival data for contextualization (Denzin, 2017; Jick, 1979).

### **Measuring Centralization using the PageRank Algorithm**

To investigate how changes in collaboration behavior aggregate to have implications for the ecosystem structure, i.e., the extent and dynamics of (de)centralization over time in the status ordering of the news media ecosystem, we conducted citation network analysis between all news organizations in the Danish news ecosystem.

In the coopetitive networks literature, a node's connectedness is usually used to assess its centrality in the network (Sanou, Le Roy, & Gnyawali, 2016). Here, the centrality measure chosen was based on the incoming citations from competing organizations, as it functions as a proxy for an organization's status by association, i.e. interorganizational endorsement (Stuart et al., 1999). Thus, what makes actors 'central' to the news media ecosystem is their ability to accumulate associations by way of citations (Brass & Burkhardt, 1992; Gnyawali & Madhavan, 2001). Key in our framework is the notion that status positions are dynamic and may change over time. Therefore, those that are central at one point in time might be peripheral at another.

Different network centrality measures have been proposed to calculate a node's importance in a network, e.g., eigenvector centrality, in-degree centrality, and betweenness centrality (Bonacich, 1987; Sanou et al., 2016). We chose the PageRank (PR) algorithm in this case for three reasons. First, the measure allows for comparing score distributions over years due to normalization. Second, the PR measure can account for directed ties in contrast to eigenvector centrality. Lastly, because PR is a relative measure, meaning that the centrality of one node depends on others, it makes it possible to treat centrality as a scarce and limited resource, which fits well with perceiving status as a commodity that organizations compete on.

We used the PR algorithm to assess the centrality of news organizations in the networks at different time points, since we conceptualize incoming citations, and the quality of a news organization's affiliates (Podolny & Phillips, 1996), as indications of an organization's status position and centrality. This is where the PR measure has advantages over for example in-degree, as a citation from a reputable competitor weighs more than a citation from a low-scoring competitor (Rieder, 2012). Further, with the granularity that the PR approach involves, we can both look at individual organization's status position trajectories over time, as well as trajectories on an aggregate level, e.g., the difference between local/regional news organizations' centrality developments versus that of national news organizations.

Building on sociological and sociometric works that induce status/influence/authority positions from network centrality measures, e.g., PageRank, Katz, or eigenvector (Bonacich, 1972, 1987; Hubbell, 1965; Katz, 1953; Pant & Srinivasan, 2010; Spitz & Gertz, 2015; Varlamis & Hilliard, 2017), we use the PR score as a measure of a news organization's position in the status order on an annual basis. All directed networks contain nodes for each active news organization for a given year, where edges are weighted by the citation counts from node X to

node Y during that year. All prior and future citations outside the given year are disregarded in the calculation of PR scores: i.e., the status order is ‘reset’ each year.

The PR algorithm is a variant of eigenvector centrality and was developed by Google’s Larry Page with the goal of ranking a website’s importance based on the amount and quality of its incoming links in large datasets (Page, 2001). The method can be understood as a simulation of a “random surfer” that randomly clicks links on webpages until they either stop or reach a page without any links (a ‘sink’). A webpage’s PR score is an expression of the probability that the random surfer will land on the webpage. For our purpose, pages are substituted for nodes in a citation network of news organizations. For each year in the timeframe, we construct citation networks and, using the power iteration method, calculate each node’s PR score with the PageRank formula:

$$PR(p_i; t + 1) = \frac{1 - d}{N} + d \sum_{p_j \in M(p_i)} \frac{PR(p_j; t)}{L(p_j)}$$

Where  $N$  is the total number of nodes,  $p_i$  is the individual node,  $M(p_i)$  expresses the group of nodes linking to  $p_i$ ,  $L(p_j)$  is the number of citations from node  $p_j$ , and the damping factor  $d$  is set to the default 0.85. The damping factor is the probability that the “random surfer” will continue clicking a link in the current step of the iteration and is introduced to avoid getting stuck in ‘sinks’ or citation loops (Page, 2001). All PR scores in a network always sum to 1. Due to the relative nature of the centrality measure, a node’s PR score is partially derived from other nodes’ PR scores (see Appendix F for details).

To assess the extent of (de)centralization in the yearly networks, we use the network centralization formula proposed by Madhavan et al. (1998), which measures the average distance between the most PR score of the most central firm to the rest in the network:

$$\text{Network centralization} = \frac{\sum C_{\max} - C(\text{node } i)}{n - 1}$$

Where  $n$  is the total number of nodes in the network,  $C$  is the PR centrality score for an individual node  $i$  and  $C_{\max}$  is the PR score of the most central node in the network.

Besides network centrality measures, we use the Herfindahl-Hirschman Index (HHI) to estimate the competitiveness in the citation market over time. The HHI ranges between 0 and 1, where an index closer to 1 indicates that one or few firms possess the majority of market shares. The index is calculated using the formula:

$$HHI = s_1^2 + s_2^2 + s_3^2 \dots s_n^2$$

Where  $s_n$  is an individual firm's market share. The sum of all squared market shares estimates the HHI. Using the measure, we assess whether fewer players obtain market power in the citation market over time.

## RESULTS

### The Rise of Bypassing Citations

With digitalization came the increasing ease of information search and the possibility of immediate reporting. This results in a higher number of news organizations in the Danish news ecosystem that adopt citation practices in their news production, as seen in Figure 1. Further, we observe that a higher fraction of nodes become connected in the citation networks during the uncertainty regarding the central firm, Ritzau. Thus, news organizations increasingly cite a wider variety of other organizations but are also increasingly cited themselves, as the distribution and consumption of news increasingly move online.

*< Insert Figure 1 about here >*

The widespread adoption of citation practices also results in an increasing number of articles that use citation over time, as seen in Figure 2. While the yearly sum of articles increased remarkably in 2009, articles containing citations also increase and over time eat into the share of articles without citations, resulting in over 40 % of all articles containing a citation in 2021.

**< Insert Figure 2 about here >**

We distinguish between orchestrated and non-orchestrated collaboration. Empirically, orchestrated collaboration is translated to citations of Ritzau, either in the bodytext or the byline of an article, due to Ritzau being a central firm with orchestrating responsibilities. We will refer to these as *orchestrator citations*. Conversely, *bypassing citations* refer to non-orchestrated and non-formalized citations of competing news organizations in the bodytext of an article. 99.98 % of all citations are orchestrator citations. A much smaller subset, comprising a total of 162.620 citations, is of the bypassing type, where the target of the citation is a competing news organization.

As previously mentioned, Ritzau experienced a crisis during 2008-2015, when owners left the cooperative and founded competitive agencies. Further, the future of the central firm was deemed uncertain by both experts and Ritzau's top management. As seen in Figure 3, the crisis is reflected in the incoming citation counts to Ritzau – its main performance indicator according to its CEO – as it drops from 2009 to 2014. While some citations did go to Ritzau's new competitors, for example, BNB, the total sum of citations to news agencies decreased during the crisis.

**< Insert Figure 3 about here >**

On the other hand, we see in Figure 3 that bypassing citations increase in the period where uncertainty arises around Ritzau, and its survival and orchestrating authority falls under

question. While the total percentage of articles containing such bypassing citations are relatively low compared to orchestrator citations, it seems that some of the orchestrator citations are replaced by bypassing citations.

To illustrate what constitutes bypassing citation and the role it has according to insiders of the journalistic field, we provide an empirical example of bypassing citation and excerpts from interviews. An example of bypassing citation was evident when the Danish reality TV celebrity Sidney Lee suddenly passed away. Following his death, a Danish tabloid newspaper, Ekstrabladet, reported on his death on their website ekstrabladet.dk (Kornø, Bjerregaard, & Erland, 2022).

Shortly after Ekstrabladet broke the story, competing news organizations published the same story on the death of Lee, many quoting Ekstrabladet on the news. Among these were big national outlets such as BT, TV2 Nyheder, Politiken, Avisen Danmark, DR.dk, and Jyllands-Posten (Avisen Danmark, 2022; DR Nyheder, 2022; Haugaard, 2022; Jyllands-Posten, 2022; Politiken, 2022). Figure 4 shows a screenshot from TV2.dk where the citation of Ekstrabladet is highlighted (Haugaard, 2022).

*< Insert Figure 4 about here >*

Translated, the first paragraph of the body text states: “The reality star Sidney Lee is dead. His family confirms this to Ekstrabladet.” As such, a competing news organization to Ekstrabladet explicitly states that they did not themselves collect the information and publish the story first, but rather assign that status to Ekstrabladet.

One could then ask why a news organization might be inclined to cite a competitor. It could be argued to be more feasible to simply publish the same story as Ekstrabladet and leave out the citation. However, among journalists, professional standards suggest one should, if

possible, cite the source of the obtained information. A feeling of obligation to such standards is voiced by several interviewees:

“[talking about taking stories from competitors] Yes you cite them. There are these rules that we have.” (Editor, local news outlet)

“We are not above citing and giving them the credit that they had the story first, and now we have joined in.” (Editor on duty, regional news outlet)

“We always cite. Often with links so people can go read the original source themselves. ... We always cite when we have to.” (Editor, national news outlet)

In the interviews, we are presented with widespread alignment to this collaborative practice, even though it would be instrumentally advantageous to simply copy the story without mentioning its source and avoid the risk of diverting attention to a competitor. A bi-product of this adherence is the generation of status that is attributed to the cited, due to them being signaled as a reputable and truthful source by competitors that consciously and explicitly trust and rely on the information they distribute. This interpretation of citations as a status indication was also indicated in interviews, for example in this excerpt:

Interviewer: “My preliminary analysis shows your organization is among the most cited media in Denmark.”

Editor, national news outlet: “Okay, that is great to hear.”

Interviewer: “Interesting you say that it is great to hear. What do you base that on?”

Editor, national news outlet: “Yes, I think so. That other journalists cite us. ... I would rather have others citing us than the opposite: that we would be citing other Danish media.”

...

Editor, national news outlet: “... it is of course a journalistic endeavor to be the ones that are the first and the best. It has to be, I think. That we have stories that are so important to the agenda that others need to cite us, I absolutely think that is positive. As I said, it is preferable to be in that part of the food chain than to be at the other end where you must go hunting elsewhere to tell the stories you find necessary. ... When I went to journalism school, it was seen as a quality stamp if you had made a story- Especially if it was cited in [national radio news broadcast] and other places.”

Although it should be noted that journalists and editors in interviews emphasize citation can also be a way to disclaim liability:

“[talking about why a news agency cites] ... They are keeping it at an arm’s length ... So, if there are comments to the content or something is wrong, then you need to contact the originator. Not [the news agency], they are just a mediator. ... It is very clear in the distribution itself, that this does not come from [news agency’s] newsroom.” (Editor, national



media house)

The rapid reporting on Lee's death left little time for fact-checking. Therefore, the risk of reporting something false based on a rumor emerges. In this case, citing a competitor, as TV2 does, can be a way to report on a story that is urgent and at the same time disclaim liability of the reported information. If the information later turns out to be incorrect, responsibility can be put on Ekstrabladet, and less so on TV2 itself. Whether the reader would see it this way, however, is less clear – and in the event of truthful reporting, citation continues to generate status for the cited.

Following our premise that high status signals a central position in the ecosystem structure, such citations from outsiders may improve a firm's competitive performance (Gnyawali et al., 2006). Further, the example highlights well the ambivalences that characterize collaboration and competition dynamics in ecosystems (Hannah & Eisenhardt, 2018). On one hand, actors collaborate on inputs, here the information on Lee's death, but on the other hand, actors compete for reader attention: paradoxically by mentioning competing organizations during that chase.

Based on our empirical findings, we find evidence in support of H1 which states that complementors, in this case news organizations, turn to decentralized orchestration and bypass the formal orchestrator, when the central firm's survival is put into question.

### **Changes to the Ecosystem Structure**

During the crisis and the subsequent rise of bypassing citations, Ritzau's central position in the ecosystem diminishes. This is observable if the networks for different years are visualized, where a network from 2008 (Figure 6) shows a network that is highly centralized around one purple node (Ritzau) with limited amounts of ties between other nodes. However, the network

from 2013 shows a network with more nodes than earlier, and more edges between nodes that are not agencies, i.e., citing that circumvents the orchestrator becomes more widespread. In other words, the networks take on a more decentralized structure during the peak of bypassing citation activity. This is also apparent in Figure 5.

*< Insert Figure 5 about here >*

As seen in Figure 5, Ritzau's centrality decreases during its crisis. Further, a dip in the increasing centralization trend is taking place during the Ritzau crisis, suggesting that the network becomes relatively more decentralized during the peak of bypassing citations. One could argue that this is a more 'durable' ecosystem structure, compared to a more centralized structure, where there is greater reliance on the survival of a single node and higher vulnerability to unexpected exits or shocks (Uzzi, 1997). In contrast, the decentralized structure enables the network to survive despite other nodes potentially breaking away from the ecosystem.

*< Insert Figure 6 about here >*

After the Ritzau crisis, we see that bypassing citations decrease again, seemingly in favor of Ritzau citations which once again increase (Figure 3). This is also observable in Figure 6 as Ritzau returns to a more central position in 2018 which continues for the remainder of the analyzed period. In interviews from 2022, editors and journalists also highlight how Ritzau has improved in recent years, for example:

“[talking about their use of Ritzau products] ... They are doing a really, really, good job, Ritzau. They have had a really great development during the last couple of years ... They got some competition a while back that they really sharpened their focus on what we [news outlets] need and are very attentive of our needs ... Not as much the consumers out there, but is [news outlets] as customers, and we have a really good collaboration with them.” (Editor, national media outlet)

This perception of Ritzau being more attentive to the needs of the ecosystem complementors may explain the increasing citations of the central firm. However, despite

Ritzau's return to a central position, we still observe edges between nodes outside Ritzau to a greater extent than earlier in 2018. This suggests that the orchestrator bypass was to some extent a temporary solution to the uncertainty regarding the central firm, although it did not dissipate once Ritzau overcame its crisis. Instead, bypassing citations co-exists as a niche strategy alongside orchestrator citations. One explanation for why orchestrator bypass remains a niche strategy could be that the momentum of the strategy was slowed due to Ritzau's return to a confident and high-status position in the news ecosystem, which diminished the need for bypassing the orchestrator and assigning status to competitors. Another explanation for the downward trend in bypassing citations from 2014 to 2017 could be that *Danske Medier*, the industry association for Danish media organizations, came to a – in an interviewees terms – “gentleman agreement” (Editor, national news outlet) in 2014 that outlined guidelines for citation behavior (Danske Medier, 2014). Thus, the once non-orchestrated collaboration practices was made formal and orchestrated, with sharpened guidelines that might have deterred news organizations from its use:

“... It is a gentleman's agreement. It has no legality to it, but it is something we are very concerned about from our side. I think several other media also care about it, as all the major Danish media outlets have made a joint declaration on how we cite each other. (Editor, national media outlet)

However, given the rise of Ritzau citations during 2014, our evidence suggests that it was likely the returning confidence in the Ritzau project and orchestrated collaboration that led to the decrease in bypassing citations at that point.

Thus, we find that the uncertainty regarding the central orchestrating firm led to an ecosystem that was less dependent on Ritzau as a key hub for citations, and instead a more connected network outside Ritzau, i.e., a decentralized structure. As Ritzau returns to its central

position, and certainty regarding the central firm's survival and orchestrating authority returns, the bypassing citation strategy lost momentum. We thus find evidence in support of H2, since the ecosystem changes toward a decentralized structure due to orchestrator bypass, as reflected by a less unequal distribution of status.

### **Who Gains from Decentralization?**

As previously stated, the advent of non-orchestrated collaboration during the Ritzau crisis resulted in an ecosystem network structure that was more widely connected independent of Ritzau. In other words, the network structure became relatively more decentralized during the crisis. As previous research shows that market uncertainty can lead to an orientation toward social structural positions when considering exchange relationships (Podolny, 1994), the question of which ecosystem actors benefit the most from the Ritzau crisis emerges.

In Figure 7 the mean PR scores for different segments<sup>4</sup> of the news ecosystem over time are visualized. We observe two main 'waves' of increases in mean PR scores for different segments around 2013-2014 and again in 2018-2020. The first takes place during the Ritzau crisis and in the years when bypassing citations are at their highest intensity. The last wave coincides with a return of an increasing count of bypassing citations.

*< Insert Figure 7 about here >*

While the different segments in general follow the same wave pattern, the peaks are higher for some than others. For example, high-trust news organizations receive higher mean PR

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<sup>4</sup> The segmentations were coded manually based on publicly available information on national news organizations and data on reported trustworthiness from a Danish survey released in 2022, with a representative sample (on age, gender, and religion) for the Danish population (respondent  $N = 1,337$ ). Respondents report trust in a total of 17 Danish nationally oriented news brands on a scale from 0 (very bad trust) to 7 (very high trust). Previous research shows that trust levels in Danish news brands remain very stable over time (Andersen, Van Dalen, Hopmann, Skovsgaard, & Albæk, 2021). Therefore, the scores from the survey are used as a proxy for trust in news organizations throughout the entire period.

scores than the overall legacy media segment does. Further, the news organization type that achieves the highest PR scores, outside news agencies, are the organizations characterized as daily newspapers, e.g., Berlingske and Politiken. As both high-trust and daily organizations are primarily the oldest and already well-established high-status players in the Danish news ecosystem, the turn to bypassing citations seems to favor the pre-crisis higher-status players more than the mid- or lower-status organizations in the ecosystem. In a sense, the status that Ritzau lost during its crisis was primarily redistributed to the other high-status actors in the news ecosystem, and less so to mid- or lower-status actors. These findings align with expectations set forth in the status literature, where market uncertainty is argued to narrow the field of potential partners to players with whom the organization has already dealt – the high-status actors – as a satisficing solution (Granovetter, 1985; Podolny, 1994). We find the same logics voiced in interviews with editors:

“[talking about citing other media] ... For example, if you were to quote something like Times Magazine or a more colorful celebrity magazine from the US ... Then I could not imagine that you would then add, "writes Times Magazine" without also adding "according to AP" [an American news agency], because they have then assessed whether it was true or not.”  
(Editor, national media outlet)

We see in the excerpt that the existing understanding of status and trustworthiness of other sources are used as a shorthand to assess the quality of information, and that citing a low- or mid-status organization is less likely without the endorsement of high-status organizations, e.g., AP.

However, concentration measures show that the Ritzau crisis instantiated a period of decentralization, where PR scores became more equally distributed across the network. For example, the HHI on PR scores decreased during these years (Figure 8).

Thus, we find evidence that the adoption of bypassing citation strategies is associated with network decentralization in our data. This means that the status ordering in the news ecosystem, compared to before, becomes less concentrated at the top during the crisis, as it becomes reshuffled due to the reactions to uncertainty. It should be noted however, that Ritzau retains its position as the highest PR scoring node throughout the entire period, although its PR score is less extreme compared to before and after the crisis. Thus, while the Ritzau crisis was to some extent a “structure-loosening” event (Madhavan et al., 1998), it did not revolutionize the ecosystem structure completely.

Despite high-status actors being the main beneficiaries of the reshuffling of the status order, we see indications that the market for citations become less concentrated due to bypassing citations, as seen in Figure 8.

*< Insert Figure 8 about here >*

When we compare the market share of the top 10 most cited organizations to the rest, we observe that they get a relatively lower market share during the Ritzau crisis compared to before and after the crisis. This suggests that news organizations cited more broadly in the network during the crisis, and not exclusively the high-status organizations. Looking at all organizations, the HHI decreases during the Ritzau crisis, which is likely a product of Ritzau’s decrease in citations and the increase in bypassing citations, as a wider selection of nationally oriented news organizations receive citations, rather than a select few.

Based on these findings, we find moderate support in favor of H3 which states that the main beneficiaries of the move toward a decentralized ecosystem structure are pre-established high-status organizations. While many organizations benefit from the structure-loosening event

of the Ritzau crisis, it indeed favored pre-established high-status organizations relatively more compared to mid- or low-status organizations.

## DISCUSSION AND CONCLUSION

Orchestrated collaboration has been a norm between news organizations in different forms, notably through news agency cooperatives which have been jointly owned and governed by competing news organizations as far back as the 19<sup>th</sup> century. However, due to the advent of the Internet and digitalization of the news ecosystem, transaction and information search costs drastically reduced for actors in digital ecosystems (Adner, 2017). Our analysis shows that this, coupled with a crisis surrounding the ecosystem's central firm, enabled the rise of a new form of collaboration in the news ecosystem that was not possible pre-digitalization: non-orchestrated collaboration through real-time surveilling and citing competing news organizations without needing to go through a central orchestrator. We call this phenomenon *orchestrator bypass*. In the case of the news ecosystem, orchestrator bypass is expressed as direct citations between complementors without orchestrated collaboration agreements. Orchestrator bypass may arise under circumstances defined by 1) non-orchestrated collaboration between complementors that is made possible by professional ideals and values to secure alignment without a central firm, and 2) uncertainty regarding the survival and orchestrating authority of the ecosystem's central firm which incentivizes alternative collaboration practices to secure firm and ecosystem persistence. The citation practices we observe in the news ecosystem fit the parameters of orchestrator bypass. Where the literature has primarily focused on how ecosystems are governed and ruled by the firm in the orchestrator position, we show that complementors may also self-organize and set rules for collaboration without the need for a central firm to align the complementors. This was

the case in the Danish news ecosystem during the crisis experienced by its central firm. However, we propose that orchestrator bypass may not be tied to the news context, but could emerge in other ecosystems, where the central firm experiences crisis. One could for example imagine that complementors in the current Android ecosystem would self-organize and collaborate directly with each other, if the Android project were to be abandoned by Google, or if the survival of Google itself hypothetically came into question, e.g., establishing alternative app stores or ROMs.

Current work considers the creation, strategic challenges, and dynamics of business ecosystems (Jacobides & Lianos, 2021a, 2021b; Kapoor, 2018). This literature considers, for example, how platform ecosystems can be governed (Cusumano, Gawer, & Yoffie, 2021; Kretschmer et al., 2022), how interdependent firms navigate competition and collaboration (Hannah & Eisenhardt, 2018; Kapoor, 2013; Sanchez, Galvin, & Bach, 2023), and how ecosystems evolve and react to uncertainty and entrants (Johnson, Bock, & George, 2019; Teng & Jacobides, 2020). Adding to this literature, our paper highlights the adaptiveness of a network-like structure in digital ecosystems with high levels of collaboration, in the form of a (temporary) move to a decentralized structure when the central actor in the ecosystem experiences setbacks. This finding questions arguments that hold that networks will be less viable as a whole if there is an unforeseeable breakdown of its core actor (Uzzi, 1997). In this case, the network did suffer from the near-failure of the central firm, as evident in an overall decrease in citations and articles during the Ritzau crisis. However, the losses were mitigated to some extent by adapting at the behavioral level toward non-orchestrated collaboration and at the aggregate ecosystem level toward a decentralized ecosystem structure. Thus, uncertainty and the potential loss of the central firm may not necessarily lead to the demise of a functional system, if embedded actors in the



ecosystem collectively, although informally, abide by mutually fair non-orchestrated collaboration agreements. While the collaboration patterns we document are tied to the Danish news ecosystem, we find it likely that similar patterns in other contexts will be observable. If future studies of digital ecosystems corroborate our results, it might point to adaptiveness and durability during uncertainty as a characteristic of digital ecosystems with high levels of collaboration.

Our study has three main limitations that should be addressed in future studies. Firstly, as we do not have access to full-text articles, we cannot analyze the content of cited and non-cited news articles, even though this would likely have provided useful insight into the extent to which citation is conditioned on for example story type, timing, or language features. Secondly, we cannot trace articles that copy from competitors without citing them, as our scraping procedure involves explicit mentions of the source. We therefore do not know whether the decreases in citations, or the relatively small size of bypassing citations, may be due to an adoption of adversarial tactics such as copying competitors, in violation of the professional ideals and values among journalists. Lastly, there is a risk of memory distortion being present during the interviews, as the Ritzau crisis took place more than 10 years ago at the time of writing. Thus, interviewees may recall events and reasonings differently than they played out back then, when asked in interviews. Despite these limitations, our methodological framework offers an approach to quantitatively trace changes in collaboration practices and the resulting ecosystem structure over time, while triangulating the results with qualitative insights (Denzin, 2017; Jick, 1979), which can be used in future studies.

When digital ecosystems rely heavily on the performance of one actor, its structure is somewhat fragile, as unexpected shocks to the central firm will affect other interdependent actors

in the ecosystem. In those circumstances, failing to adapt to the uncertainty regarding the survival of the ecosystem's central firm could lead to collaboration breakdown and ecosystem collapse. As such, durability and adaptability are vital characteristics for digital ecosystems with democratic importance, as a breakdown of for example news coverage would be detrimental to the public democratic discussion, political communication, and important updates to citizens. Through this lens, orchestrator bypass can be understood as a viable survivability method at both the organization and ecosystem levels, as it ensures persistence despite adversity and the breakdown of single actors in the ecosystem.

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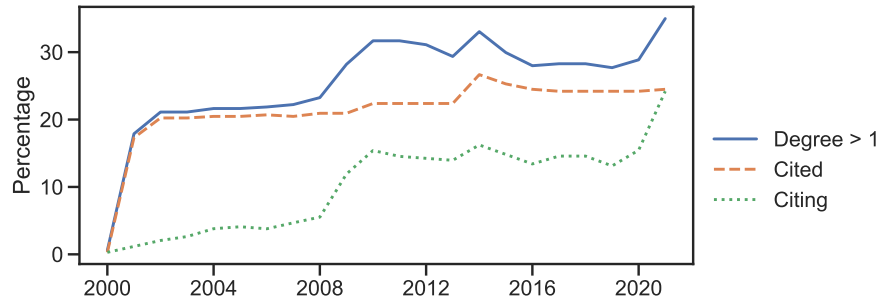
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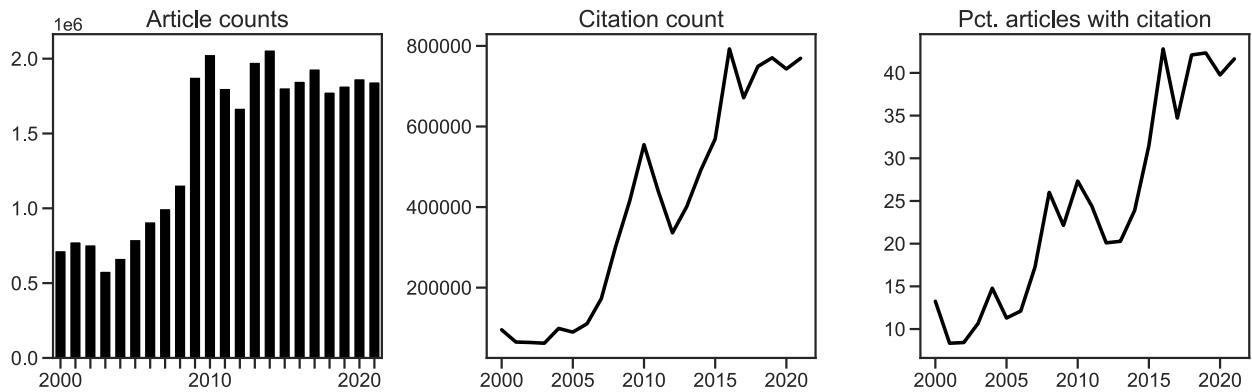
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**Figure 1: Percentage of Citing or Cited News Organizations, 2000-2021**



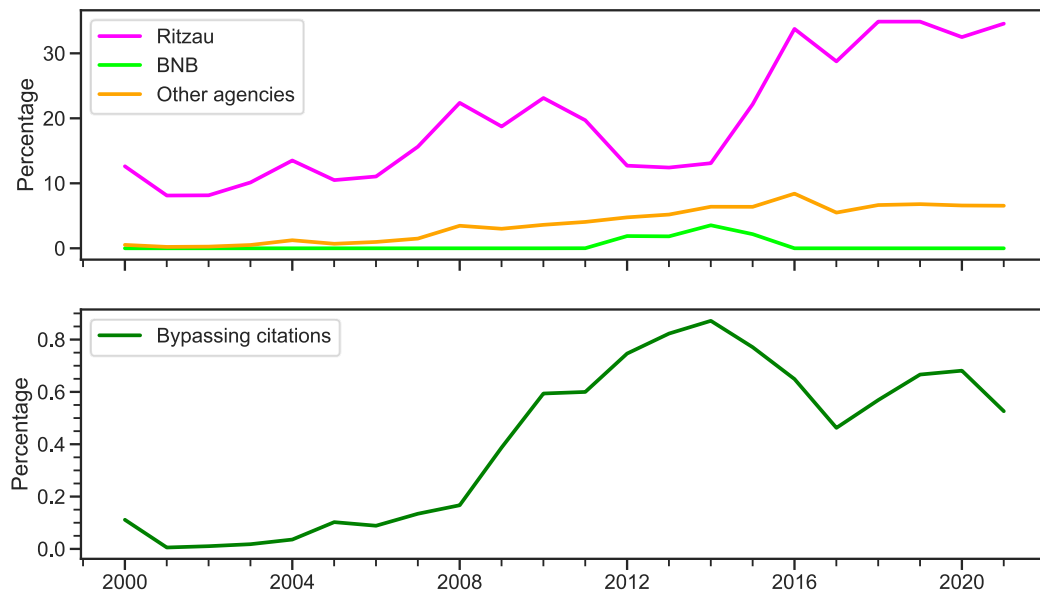
Notes: Percentages of nodes ( $N_{min} = 337$ ,  $N_{max} = 346$ ) with a degree score  $\geq 1$  in annual citation networks, i.e., nodes that are either being cited or are citing another node in the network at least once. Cited shows percentage of nodes with in-degree  $\geq 1$ , and citing is percentage of nodes with out-degree  $\geq 1$ . When the Ritzau crisis hits in 2008, we observe an increase in connected nodes in the network, and a minor decrease following the crisis. This shows that more news organizations engage with citation practices outside Ritzau in the face of uncertainty regarding the central firm.

**Figure 2: News Articles and Citations, 2000-2021**



Notes: Left: Article counts per year in millions ( $N = 31,700,129$ ). Middle: Citation count per year ( $N = 6,347,310$ ). Right: Percentage of all articles within a year containing a citation over time. Article counts increase significantly between 2009 and 2010, then stabilize over time. Citation counts per year increase over the 21-year timeframe, although decreasing in 2010-2012. The yearly percentage of articles with citations increase over time, except in 2010-2012.

**Figure 3: Percentage of News Articles Containing a Citation, 2000-2021**



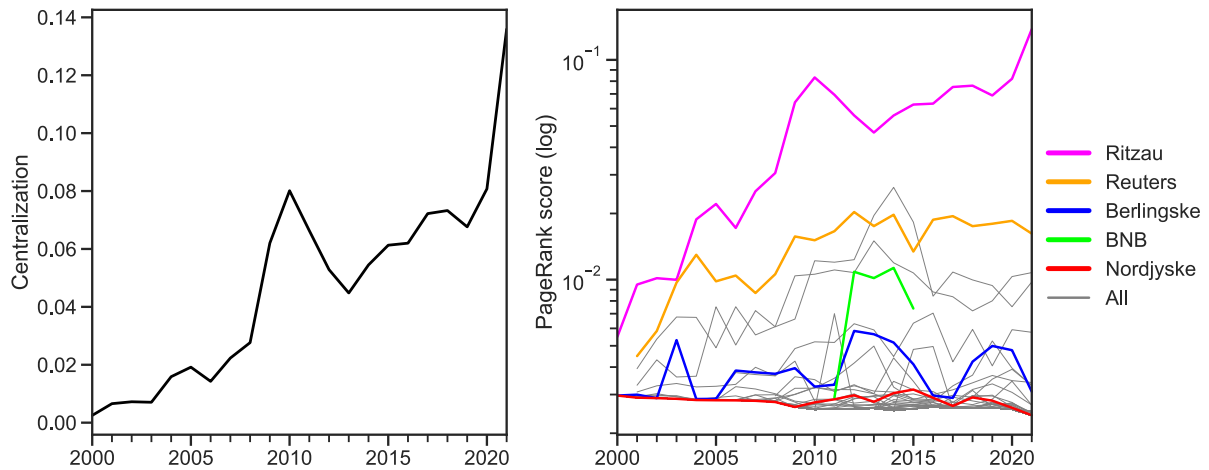
Notes: Article  $N = 31,700,129$ . Citation  $N = 6,347,310$ . “BNB” refers to Berlingske Nyhedsbureau, a competing news agency to Ritzau that launched in 2011. A Kruskal-Wallis  $H$  test was performed over three periods: before the Ritzau crisis (2000-2008), during the crisis (2008-2015), and after the crisis (2016-2022), and shows significant differences in distributions across the three periods for Ritzau ( $H = 22.50, p < 0.0000$ ), other agencies ( $H = 84.56, p < 0.0000$ ), and bypassing citations ( $H = 1206.98, p < 0.0000$ ).

**Figure 4:** Example of a Bypassing Citation



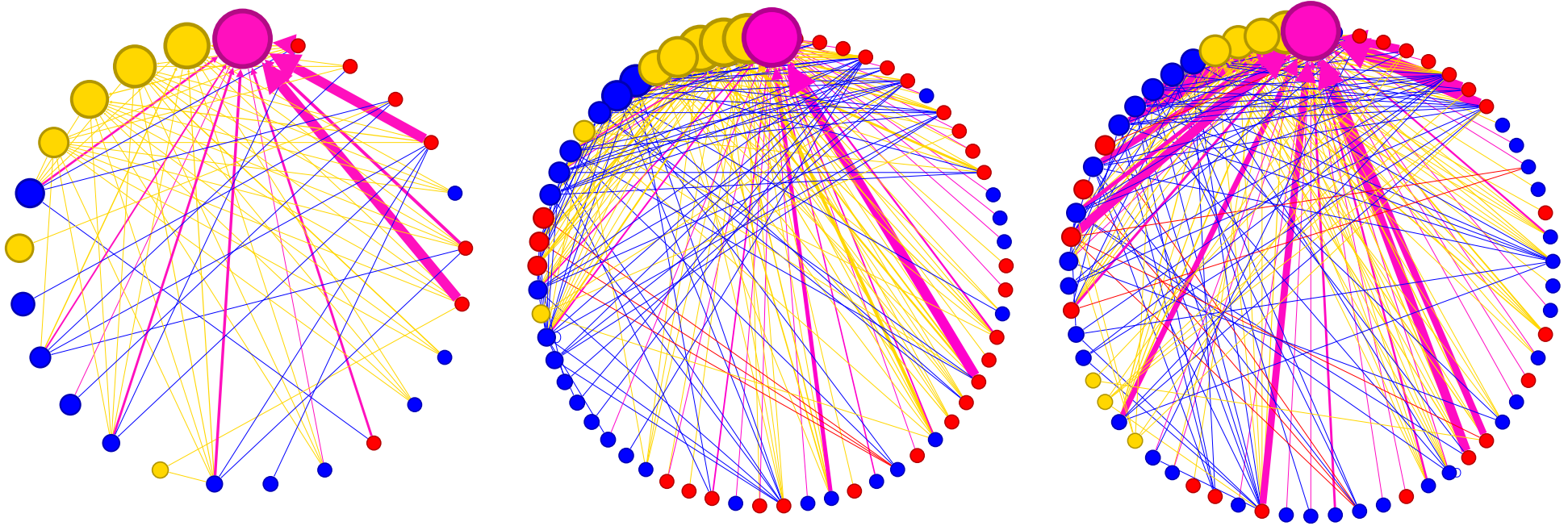
Notes: Citation of a Danish news article (highlighted in yellow) by the news website TV2.dk, August 16<sup>th</sup>, 2022, referring to a story published by the news media Ekstrabladet.

**Figure 5: Degree of Centralization in the Danish News Ecosystem, 2000-2021**



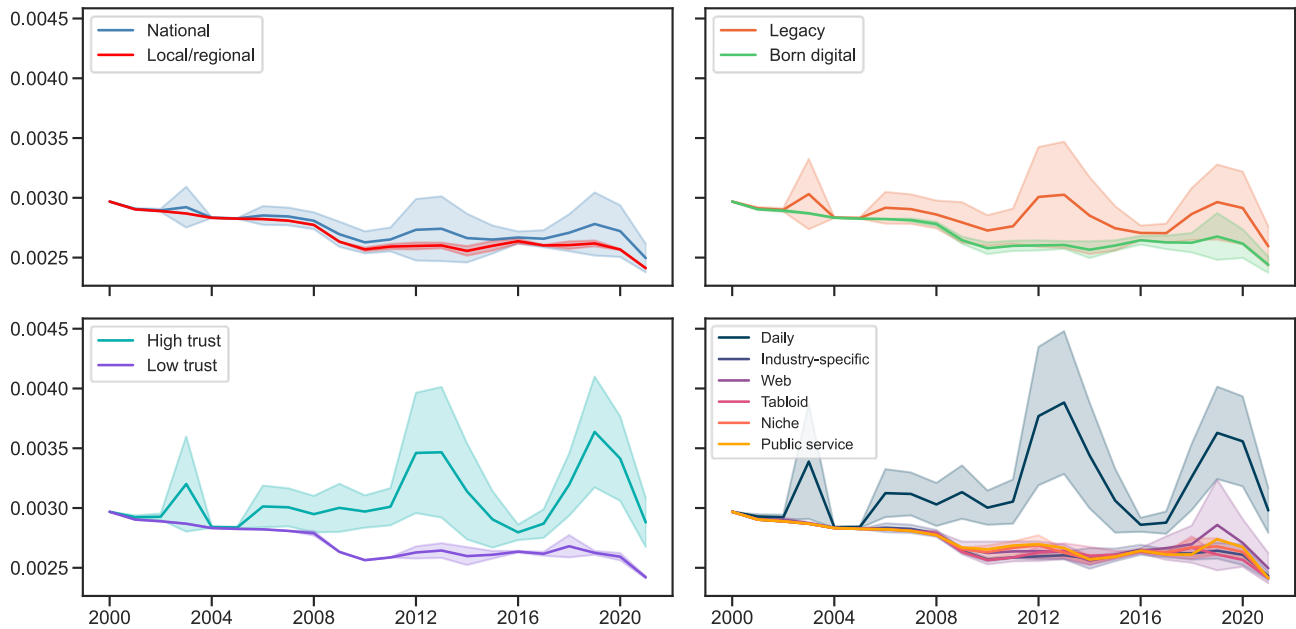
Notes: Left figure: We use the network centralization formula defined by Madhavan et al. (1998) on PR centrality scores among all nodes in the given years ( $N_{min} = 337$ ,  $N_{max} = 346$ ). At the beginning of the Ritzau crisis (2008), network centralization increases. However, as news organizations adapt to uncertainty during the Ritzau crisis and begin using bypassing citations, we observe a decentralization of the ecosystem structure as the centralization measure decreases from 2010 and three years onwards. After the Ritzau crisis (2016), the centralization increases once again and more rapidly compared to before. Right figure: Log distribution of PR scores of each node over time with example organizations highlighted in color. Notably, Ritzau's centrality has strong positive linear correlation with the network centralization variable (Pearson's  $r(20) = 0.99$ ,  $p < 0.0000$ ), suggesting that its crisis and loss of centrality impacts overall ecosystem structure. We also observe that the PR centrality of a few other nodes increase, e.g. BNB and Berlingske.

**Figure 6:** Citation Network Visualization in 2007 (left), 2013 (middle), and 2018 (right)



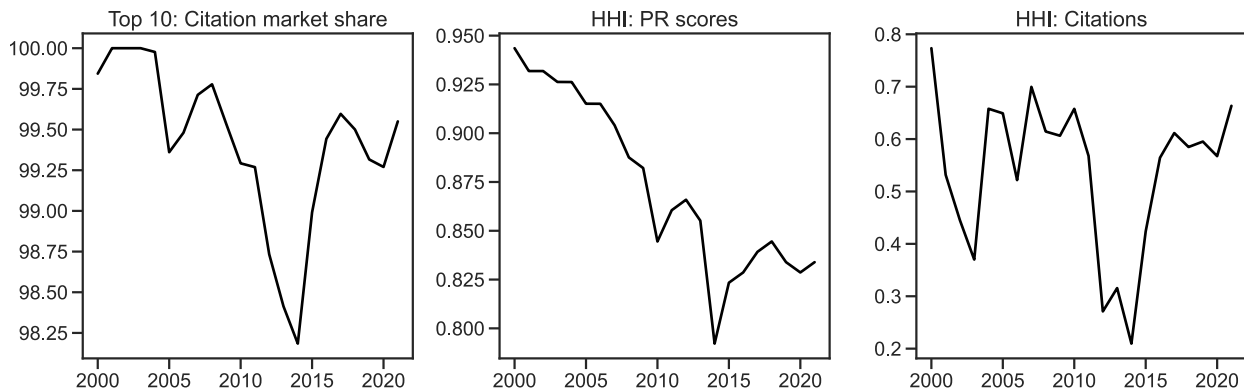
Notes: Only nodes with a degree score  $\geq 1$  are visualized, hence differences in node counts. Nodes are colored by type (blue=national organization, red=local organization, yellow=news agency, purple=Ritzau) and size indicates PageRank score (bigger is higher). Networks are ordered counterclockwise by node PR score (low to high). Where there are PR score ties, the order within the tie group is random. Edges are weighted by citation count (thickness) and edge color denote target type. We observe that Ritzau, despite achieving the highest PR score across all three years, becomes less central in 2013 compared to 2007, as more nodes are connected in the network independent of Ritzau. These ties arise in part due to bypassing citations. The networks become more decentralized as citations are more dispersed throughout the network. Ritzau returns to a very central position in 2018, although ties between other nodes are still present.

**Figure 7: Mean PageRank Scores within Organization Type Samples, 2000-2021**



Notes: National = national news coverage. Local/regional = local/regional news coverage. Legacy = ‘traditional’ national newspaper before digitalization. Born digital = national media organization founded after digitalization (web only). High trust = over 5 in reported trust from 2022 survey (respondent  $N = 1337$ ). Low trust = below 5 in 2022 survey (respondent  $N = 1337$ ). Daily = national daily newspapers (i.e., ‘legacy media’). Industry-specific = nationals covering only one industry/topic. Web = national news organizations covering only on the web. Tabloid = national web/physical newspapers on celebrities and entertainment. Niche = national “niche” web/physical newspapers, e.g. *Kristeligt Dagblad*. Public service = national public service outlets (DR).

**Figure 8: Concentration of Citations and PR Scores, 2000-2021**



Notes: Left: annual citation market shares for the top 10 most cited organizations within each year. Middle: Annual HHI on PR scores within year. Right: Annual HHI on the entire citation market. Overall, results show that the market for citations in the news ecosystem become less concentrated during the years of the Ritzau crisis, as the market share of the top 10 and HHI on both citations and PR scores temporarily decrease in that period.