The London School of Economics and Political Science

Social media platforms as economic organisations: Reconstructing the evolution of TripAdvisor's operations

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Abstract

Social media platforms have gradually become embedded in the digital economy. During this process, their original identity as sites that exclusively facilitated content sharing and user networking has changed significantly. The so-called "social media" literature has traditionally centred on user's capabilities to networking, sharing content and building community. The "digital platforms" literature has focused on the rules, conditions and governance of resource exchanges between multiples sides of a platform. The "ecosystem literature" has focused on understanding the emergence of a complex web of commercial relationships that prompt value creation. Meaningful as they are, current literature tends to treat technology as a black box by overlooking the ways it moulds perceptions, attitudes, relations, and actions. This study fills this gap by critically examining the role of data and technology in social media platforms. It argues that social media form part of the digital economy by developing both technological and organisational capability to exploit data systematically. The thesis advances these ideas through the study of TripAdvisor from its creation in 2000 through 2019. It uses qualitative analysis complemented with digital methods. The analysis reveals several stages in TripAdvisor's evolution. Each stage is closely related to TripAdvisor's capabilities and strategies for procuring, producing and exchanging data with its ecosystem. The thesis develops a general framework that contributes to uncovering the technological, organisational, and economic complexities involved in the evolution of social media. It explains the structural transformations of social media platforms and their current embeddedness in webs of relationships, characteristic of the digital economy. The thesis suggests that the platform's identity is the result of an intricate interplay of strategies, technology, actors, relationships and practices that influence and reinforce one another.

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Papers of the thesis

The thesis comprises three papers, fruit of my research conducted during my enrolment in the PhD in Information Systems and Innovation at the Department of Management, London School of Economics. This dissertation presents original and extended versions of papers that have been published or are under the reviewing process.

1. Alaimo, C., Kallinikos, J., and Valderrama, E. 2020. "Platforms as Service Ecosystems: Lessons from Social Media," *Journal of Information Technology* (35:1), SAGE Publications Ltd, pp. 25–48. (https://doi.org/10.1177/0268396219881462). Original version.

2. Kallinikos, J., and Valderrama, E. "Patterns of Digital Transformation – A Study of TripAdvisor," *Manuscript under review*. Original version.

3. Alaimo, C., and Valderrama, E. 2020. "Boundary-making and the evolution of platform ecosystems - the case of TripAdvisor," *Academy of Management Proceedings*. Extended version

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Abbreviation

API   Application Programming Interface

HTML   Hypertext Markup Language

IS   Information Systems

IT   Information Technology

IBE   Internet Booking Engines

OTA   Online Travel Agency

RSS   Really Simple Syndication

SDK   Software Development Kits

TAN   Travel Ad Network

Chapter 1

Overview: Theoretical and Methodological Foundation

Introduction

In 2018 Facebook and Cambridge Analytica were disclosed as the protagonists of a big data scandal. This scandal exposed the massive harvesting of Facebook user data that had been used to influence voting in the 2016 US presidential elections. Cambridge Analytica had accessed the data of more than 50 million Facebook users, collecting information on their activities, networks, and interests. The data helped the Trump campaign to predict which users were most likely to change their voting intention before microtargeting users with political propaganda. While using users' data for a massive political campaign was probably new, exploiting this sort of data was not. Facebook – like other social media platforms – had built its empire by amassing, extracting, and exploiting its users' data.

The extensive tracing and exploitation of users' data for commercial purposes was not originally a hallmark of social media. At its inception, social media disrupted the digital world by letting ordinary people called "users" interact online for the first time which signalled a drastic change in paradigm (Jenkins, Purushotma, Clinton, Weigel, & Robison, 2006; Kallinikos & Constantiou, 2015; van Dijck, 2013). The enormous responsiveness of users was what propelled social media platforms to their current status in the digital

economy. Users online activities came to characterise social media platforms, and this characteristic persists today.

Over their brief lifetime these platforms have undergone significant change. Social media platforms began in the late 1990s as stand-alone websites that facilitated user interaction as well as content sharing and networking (boyd & Ellison, 2008; Ellison & boyd, 2013; Kaplan & Haenlein, 2010). As the technology evolved, social media platforms began to interoperate with other digital platforms by means of new features that could be used across other sites (Kane, Alavi, Labianca, & Borgatti, 2014). This interoperability has allowed social media platforms to expand their radius of actions far beyond their boundaries (Gerlitz & Helmond, 2013). For instance, the Facebook "like" button, which now populates the web, has enabled Facebook to know far more about its users' interests than if the button had been confined solely to the Facebook platform.

Today, social media platforms undertake large-scale data operations to procure, process and trade users' clicks across a broad spectrum of digital platforms (Alaimo & Kallinikos, 2016, 2017; Gerlitz & Helmond, 2013; Zuboff, 2019). Certain platforms are even beginning to diversify their operations by offering commercial services. For instance, YouTube now has thousands of films for users to rent or buy and then watch on any internet-connected device. Facebook has developed payment services via its Messenger app and is planning to launch a cryptocurrency by the end of 2020. LinkedIn is providing recruitment services. Although this commercial expansion is limited to a small number of social media businesses, it may represent a turning point in the role of social media in the digital economy.

These changes invite to questioning about the way in which social media platforms have achieved their current status in the digital economy. The existing literature offers some explanations, but still not fully answered. One strand of literature – the so-called "social media" literature – employs a user-centric perspective (e.g. Berger, Klier, Klier, & Probst, 2014; boyd & Ellison, 2008; Ellison & boyd, 2013; Kane et al., 2014; Kaplan & Haenlein, 2010; Shirky, 2008). This literature stresses the importance of users' capabilities to networking, sharing content and building community. A second strand, the "digital platform" literature, looks at social media as a marketplace (e.g. Boudreau, 2010; Evans & Schmalensee, 2016; Evans, Schmalensee, Evans, & Schmalensee, 2005; Parker, Van Alstyne, & Choudary, 2016; Rochet & Tirole, 2003, 2006). This literature studies how digital platforms, including social media, bring together diverse business actors and facilitate an exchange of resources that benefit all the sides and the platform itself. A third strand, the "ecosystem" literature, explores the complex web of commercial relations that surround social media platforms today (e.g. Adner, 2017; Gawer, 2009, 2014; Jacobides, Cennamo, & Gawer, 2018; Langlois, 2003; Mcintyre, Srinivasan, Afuah, Gawer, & Kretschmer, 2020; Nieborg & Helmond, 2019).

Insightful as these strands of literature are, however, each of them tends to treat technology as a black box, ignoring the underlying technologies (Faulkner & Runde, 2019; Grover & Lyytinen, 2015; Orlikowski & Iacono, 2001; Swanson, 2020) through which digital platforms support their operations and business objectives. These strands pay little attention to the link between technology and data and the proliferation of complex data operations through which social media platforms sustain their commercial relationships. Moreover, although each strand of literature acknowledges the evolving

nature of social media platforms and their ecosystem, it also tends to focus on digital platforms at single points in time. The evolution of social media platforms and their ecosystem remains untheorised (de Reuver, Sørensen, & Basole, 2018; Eaton, Elaluf-Calderwood, Sorensen, & Yoo, 2015; Mcintyre et al., 2020).

This study attempts to fill these gaps. It addresses two, heretofore neglected areas in research on social media. First, it pays close attention to the association between technology and data that have sustained social media operations over time. This study, in particular, focuses on analysing the way that such operations are related to the commercialisation of data, the platform's expansion and its embeddedness in the digital economy. Second, it examines the evolution of social media platforms. Specifically, it argues that social media platforms evolved within the digital economy by developing the technological and organisational capability needed to exploit digital resources and data systematically.

To make this claim, the thesis uses a case study research design to explore, in detail, the patterns of TripAdvisor's operational transformations from its creation in 2000 through 2019. As the largest social media platform in the tourism sector today, TripAdvisor provides an excellent lens through which to study the evolution of a social media platform within the digital economy. The primary sources of evidence used to study the evolution of this social media platform were the TripAdvisor media centre archive and the Wayback Machine archive. Digital records from the media centre archive provided a public account of events that marked TripAdvisor's history and the Wayback Machine archive documented, over time, TripAdvisor's webpages, the interface where users interacted.

This dissertation employs qualitative methods that are complemented with digital methods. Digital methods consist in adapting pre-existent computational techniques to study a phenomenon; in this study, the evolution of social media platforms. The analysis proceeds inductively from observing specific empirical evidence to developing analytical propositions concerning the platform's evolution. Three stages in TripAdvisor's evolution are elucidated: its profile as a search engine, a social media platform and a provider of commercial services. These stages are closely tied to the platform's capability for procuring, producing and exchanging content and data with heterogeneous actors in the ecosystem.

This thesis makes significant contributions to the field of digital platforms, platform evolution and ecosystem. It develops a general framework that helps to reveal the technological, organisational, and economic complexities of the evolution of social media platforms. It explains in detail the structural transformations of social media platforms and their current embeddedness in webs of commercial relationships that are characteristic of the digital economy. This dissertation also contributes to the field by providing a new theoretical lens through which to study social media platforms, in which explanatory concepts such as strategy and roles are linked to technological processes in the end-user interfaces. The research suggests that the platform's operational identity is the result of an intricate interplay of technology, actors, strategies, and relationships that influence and often reinforce each other.

This chapter unfolds as follows. Section one presents an overview of the theoretical foundations for this thesis. It presents a brief background of the relevant literature, highlights the gaps in explaining the evolution of social media, and states the research

question. Section Two introduces the methodological perspectives, purpose, and motivation for this study. It provides a detailed explanation of the case study approach, including the selection of the cases and the research phases. The last section of this chapter outlines the main arguments of the three papers that comprise this thesis and highlights their connections. Chapters 2, 3 and 4 present those papers, which address the evolution of social media by focusing on data services, technology, and relationships respectively. The concluding chapter reflects on the broader implications of the study and possible directions for future research.

Background and positioning

The previous section highlights the importance of technology and data for understanding the current social media landscape and its evolution. This section provides an overview of the context in which this research is situated. Three strands of literature relevant to this study are presented: social media, digital platforms, and ecosystems. It concludes with a discussion of the rationale for the current research, specifically concentrating on the role of technology and data in the evolution of social media platforms.

We live in a digital age where technology is omnipresent in our daily activities. In fact, more than half of the world population is online[1]. This technological connectivity shapes almost everything we do – from buying goods, to finding an address, a friend, a taxi or

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[1] https://internetworldstats.com/stats.htm

even finding love. The rapid growth and ubiquity of digital technologies have not only reshaped the fabric of everyday life, they have also formed a pillar of the digital economy[2].

Social media platforms have emerged as a by-product of Web 2.0 technologies, and they disrupted the digital world by allowing ordinary people called "users" to generate content on issues in what was previously the exclusive domain of experts such as journalists (Kallinikos & Constantiou, 2015). This drastic change in paradigm was described as an "online participatory culture" (Jenkins et al., 2006), wherein users were increasingly involved in creating web content as well as in consuming it. By the middle of 2019, social media penetration had reached one-third of the global population[1]. Social media have permeated our lives in such a manner that it is difficult to picture a day without them.

The rapid adoption of social media platforms and their social, organisational and economic impact have attracted diverse and cross-disciplinary research. Despite the value of these studies, they provide a partial view of social media platforms. In particular, they lack a full account of the role of technology in social media platforms (Faulkner & Runde, 2019; Grover & Lyytinen, 2015; Orlikowski & Iacono, 2001). At the same time, today's social media platforms differ dramatically from their earliest manifestations. Though this evolution has been acknowledged, its study remains largely neglected (de Reuver et al., 2018).

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[2] The culmination of economic activities from the everyday online connectivity among people, organisations, and technologies.

Much of the early "social media" literature has focused on studying the attributes relevant to foster networking among users or community building. This "user-centric" approach conceives of social media as online sites that merely enable user interactions, networking and content sharing (boyd & Ellison, 2008; Ellison & boyd, 2013; Kane et al., 2014; Kaplan & Haenlein, 2010). This literature stream has accordingly emphasised the ability of users to create profiles, list of contacts, and to employ further those contacts (boyd & Ellison, 2008). These capabilities allowed users to communicate with each other in ways that were too complex and therefore unfeasible in previous online applications or face-to-face interactions. In this way, social media prompted a new mode of sociality, one mediated by technology. As van Dijck (2013) sharply articulated, "making the Web social" in reality meant "making sociality technical".

Though user participation is the essence of social media platforms, we cannot fully account for social media phenomenon without understanding the dynamics of the technology which makes them possible. Social media platforms are socio-technical apparatus where actors, including users, and technology mutually interact and shape one another (Alaimo & Kallinikos, 2017; Bucher, 2012; Niederer & van Dijck, 2010; van Dijck, 2013).

As social media platforms increased their involvement in the digital economy, the economics of social media became relevant to understanding their current status and evolution. Social media platforms came to be understood as digital channels for market exchanges that enabled the connection between diverse actors and leverages new services, products or businesses (Parker et al., 2016).

A second body of literature studies social media platforms as economics entities. This "multisided markets" approach has focused on the rules, conditions and governance of resource exchanges between sides in which actors directly or indirectly engage. In this view, a social media platform provides a digital medium that enables value creation between consumers, producers, and third-party firms sides (Evans & Schmalensee, 2016; Parker et al., 2016). The central feature of digital platforms is to drive the matchmaking between the parties and orchestrate the exchange of external resources (Boudreau, 2010; Evans & Schmalensee, 2016; Parker et al., 2016). The greater the number of consumers the platform attracts, the more producers and third parties are interested in joining it and vice versa.

However, to regard social media platforms as simply tools for user participation, or as communication channels, is to obscure their organisational and economic complexity. In this sense, the economic perspective provides a welcome addition to the body of literature by emphasising their economic importance. However, understanding social media platforms as a mere marketplace downplays the role of users and of technology in shaping the platform's operations.

A third body of literature relevant to understanding social media platforms is derived from ecosystems studies. This literature looks at the formation of an intricate web of relationships and helps to unravel the complex relationships in which social media platforms are today embedded. Over the years, social media platforms have moved from being stand-alone platforms to interoperate with a broad spectrum of other actors, initially with other social media platforms and later with a wide range of internet-based applications and businesses (e.g. website, platforms and mobile apps). This

interoperability has dramatically changed the digital landscape since the inception of social media platforms in the late 1990s (Gerlitz & Helmond, 2013; Kane et al., 2014).

The ecosystem literature studies the emergence of relationships and interdependencies among a number of actors. It pays close attention to the configuration of intricate structures and forms of organising that sustain value creation among the ecosystem's actors (Gawer, 2014; Henfridsson, Nandhakumar, Scarbrough, & Panourgias, 2018; Tilson, Lyytinen, & Sørensen, 2010; Tiwana, Konsynski, & Bush, 2010; Yoo, 2013; Yoo, Henfridsson, & Lyytinen, 2010). This approach predominantly looks at the way in which a focal platform establishes relationships with third-party complementors to procure resources, usually digital, and builds up complementarities to value creation. Recently this perspective shifted from a focus on a "focal" platform to the value created by multilateral relationships and interdependencies that are non-hierarchically controlled (Adner 2017; Jacobides et al. 2018). It emphasises that the value created as a result of these relationships is greater than that created by the sum of independent relationships. This view, using business logic, explains the formation of relationships and dependencies between a wide spectrum of actors.

The ecosystem literature is useful for understanding the complex web of actors in the digital economy. However, it fails to account for how these multilateral relationships and dependencies materialise. Considering that multilateral relationships and dependencies do not occur *ipso facto*, it is vital to understand how digital platforms sustain their relationships and govern their ecosystem (Baldwin, 2019; Kapoor, 2018; Mcintyre et al., 2020).

In summary, few would dispute that social media platforms have undergone significant change in their short history. The primary fuel for these transformations has probably been the fast-paced development of new technologies. However, the current literature on social media, digital platforms and ecosystems tend to gloss over underlying technologies. The few studies that seriously examine the role of technology in social media platforms reveal an intricate apparatus of human and technological operations, each of which shapes the other (Alaimo & Kallinikos 2017; 2019a, Bucher 2012, Niederer & van Dijck 2010, van Dijck 2013).

To overlook the inherent structuring force of both technology and data is to overlook an essential dimension of the evolution of social media and their place in the digital economy. This thesis brings together the economic, technological and organisational complexity of social media platforms without undermining the role of users. To do this, it critically examines the role of data and technology as structuring forces that mould social and economic relations and frame actors' actions. (Alaimo & Kallinikos, 2019; Faulkner & Runde, 2019, 2013; Kallinikos, Hasselbladh, & Marton, 2013; Lessig, 2006). The thesis argues that social media platforms have evolved along with the digital economy by developing both technological and organisational capabilities to exploit digital resources and data systematically.

Theoretical underpinning

The previous section discusses the literature relevant to understanding the evolution of social media platforms and their diffuse involvement in the digital economy. This section presents the theoretical approach to disentangle the dynamics and specificity of social media platforms and the ecosystems in which they are embedded. The framework

provides a theoretical base on which this research was based, one that highlights the central role of data and technology.

Technology, organisation and digital platforms

Living in the digital age, we cannot deny the omnipresence of digital technologies. They increasingly attract the attention of several disciplines. Studies of technological phenomena largely highlight the implications of these technologies rather than critically analysing the technologies themselves. Even in Information Systems (IS) studies, technologies surprisingly tend to be predominantly black-boxing (see Faulkner & Runde, 2019; Grover & Lyytinen, 2015; Orlikowski & Iacono, 2001; Swanson, 2020). This approach, though relevant, takes for granted the intrinsic structuring nature of technologies (Kallinikos, 2009, 2011; Lessig, 2006). Rather than being simply tools or conduits, technologies define the paths that can be taken, similar to that of walls in a building (Lessig, 2006). Technologies mould social and economic relations and frame actors' actions in non-trivial manners (Faulkner & Runde, 2013, 2019; Kallinikos, 2009, 2011; Lessig, 2006). The implications of technology are not insignificant and required to be paid serious attention in order to understanding the phenomenon embedded in a rich technological context.

The fast-paced advance and ubiquity of digital technologies are the essential fuel of a number of transformations to which we are witnesses. Technological changes, such as the development of the Internet, smartphones, web 2.0 technologies, machine learning, and several others, are undeniably associated with the organisational changes whereby these technologies are embedded. In a rich technological context, technologies not only have nurtured and shaped forms of organising, they also are strongly intertwined with

organisations and co-constitute one another (Alaimo & Kallinikos, 2020; Beyes, Holt, & Pias, 2020; Faulkner & Runde, 2013, 2019; Kallinikos, Hasselbladh, & Marton, 2013).

Digital platforms are today a pillar of organisational arrangements through which resources are produced, shared or distributed, and services are consumed in many settings globally (Constantiou, Marton, & Tuunainen, 2017; Cordella & Paletti, 2019; Mcintyre et al., 2020; Parker et al., 2016). Given the dense technological context in which digital platforms are embedded (Lyytinen et al. 2020), their operations are hardwired to an extensive assemblage of technologies and practices. Technologies, on the one hand, provide both the functional conditions and the means through which the platform's objectives are equipped and achieved. On the other hand, technologies shape the social actors' perception of events and circumscribe possible courses of action (Alaimo & Kallinikos, 2020; Beyes et al., 2019; Kallinikos, 2009, 2011; Lessig, 2006; Swanson, 2020).

The technological fabric of digital platforms is no doubt complex. Studies tend to focus on architecture and infrastructure, high-level conceptualisations of technologies, in which digital platforms are embedded (Hanseth & Modon 2020; Hanseth & Lyytinen, 2010; Henfridsson et al., 2018; Yoo et al., 2010). These conceptualisations are fundamental and constitute the backbone for understanding both digital platforms themselves and the way in which digital platforms establish and maintain relationships within and across diverse ecosystems and business domains. This approach, though indisputably relevant, does not help us to reveal the detailed fabric of technologically mediated operations that constitute platforms as business organisations. This thesis endeavours to face this non-trivial

challenge by unpacking the platform's everyday operations in which the social, technology and platform encounter one another.

Social media studies that critically examine the role of technology reveal an intricate apparatus of human and technological operations that shape one another (Alaimo & Kallinikos, 2017, 2019; Bucher, 2012; Niederer & van Dijck, 2010; van Dijck, 2013). What distinguishes social media platforms from others is the vital role of users in their operations (Alaimo & Kallinikos, 2017, 2019, 2020). Users engage and interact with the platform by means of a stylised form of participation that serves the platform's objectives at the user-interface (Alaimo & Kallinikos, 2017; Gerlitz & Helmond, 2013; Shah, 2019; van Dijck, 2013). The platform's user-interfaces comprise a few standardised actions (i.e. "like", "follow") through which users' activities and preferences are captured and rendered into data. These actions became an emblem of social media platforms. These interfaces have been widely seen as objects, mere conduits between users and the platform. However, user interfaces are not neutral as they actively condition both interactions and information and shape the nature of the user-platform interaction, practices and resources exchanges (Alaimo & Kallinikos, 2017; Bucher, 2012; Faulkner & Runde, 2019; Gerlitz & Helmond, 2013; Shah, 2020).

Overlooking technology and the dynamics of the fabric of technological and organisational operations, is to ignore an essential dimension in understanding social media evolution and their participation in the digital economy.

Data, operations and value chain

Social media platforms have played a crucial role in rendering everyday experience into data. By using digital devices, people leave, consciously or unconsciously, digital traces of several kinds. In Facebook, for example, users "like" friends' photos or products or share their current location. Social media platforms have leveraged the capture of preferences, activities and habits, among others – things that were previously invisible – and rendered them into data (Alaimo & Kallinikos, 2017). These data record the behaviour of the whole platform's user base, making it possible to exploit the patterns of user preferences, individually and collectively. As users' lives turn into data, data has become, as the jargon goes, the new oil.

Currently, the majority of social media platforms employ large-scale data operations (Alaimo & Kallinikos, 2016, 2017; Gerlitz & Helmond, 2013; Zuboff, 2019), sustained via the deployment of technological capabilities to standardise, structure and make data portable within and between platforms (Alaimo & Kallinikos, 2017; Beyes et al., 2020; Gerlitz & Helmond, 2013). Data operations are an essential part of the way in which social media companies produce their services and forge their commercial connections in the digital economy (Bowker, 2019; Gerlitz & Helmond 2013). Emblematic digital platforms such as Facebook or Google offer several services across platforms and within their ecosystems. Most of these services interestingly do not have any physical good to trade; instead, these services are data-made or data underwritten. For example, Facebook offers a login service that makes it possible for users to employ the same profile across several business domains. Thereby Facebook facilitates the portability of user profiles and at the same time ensures a continuous flow of data of user activities across several business

domains from which user profiles are updated continuously (Lovink & Rasch, 2013). The relations forged by trading data-driven services may be a vital characteristic of the digital age. Data, thus, not only have emerged as a critical type of resource but also as a medium to forge relations that are a vital characteristic of the digital age.

The process by which data become assets or the basis of services involves a complex intertwining of technology and platform operations. Even though data are agnostic in and of themselves (Kitchin, 2014; Constantiou & Kallinikos, 2015), the processes involved in the systematic exploitation of data are not. These processes begin with encoding into data the users' preferences, activities, and habits, among others under particular conditions (Alaimo & Kallinikos 2017; Gerlitz & Helmond 2013; Van Dijck 2013). After encoding, the data are aggregated, computed and made portable (Alaimo & Kallinikos, 2016, 2017).

The encoding occurs through a discrete number of actions available on the platform's user interface, many of which are now are standard on social media platforms. These actions include liking, sharing, following, or tagging at the perceptible level. At a less perceptible level, digital platforms have developed technologies that allow them to trace, for example, a user's location or where, on the screen, users focus their eyes. The result of encoding is called social data, discrete data tokens which allow for disaggregating users into countable actions, these being used as the basis for further computation.

Data aggregation relies upon sophisticated technologies that facilitate intensive real-time computations of users clicks. Through these technologies, the platform creates data objects by computing social data. For instance, users are data objects that result from the aggregation of likes, share and tag. These data objects then provide the basis for further

computational transformations to make data become products or contextualised services. For example, these data objects are the basis of personalisation or microtargeting advertising or data analytics.

These data operations ultimately aim to enhance the consumption of goods or information by displaying items or content more promising to appeal to users based on past collective and individual behaviour (Kallinikos & Alaimo, 2019; Konstan & Riedl, 2012; Ricci, Shapira, & Rokach, 2015). They thus determine what each user would consume, and what would not, moulding users' behaviours (Bucher, 2012; Gillespie, 2014; Kallinikos & Alaimo, 2019; Shah, 2019). The impact of data operations goes far beyond the platforms, and they have been crucial to the evolution of data practices and the development of sophisticated methods that exploit data to serve multiple purposes (Beyes, 2020; Flyverbom et al. 2018).

Few scholars may dispute that data have emerged as an essential type of resource in the digital economy whose value is reliant on their continuous updatability, portability and sharing (Kallinikos, 2007). The few studies that seriously examine the role of data in social media platforms expose the structuring force of data (e.g. Alaimo & Kallinikos, 2016, 2017, 2019; Bucher, 2012; Kallinikos & Tempini, 2014). The thesis argues that data exert a central role in social media operations, and it provides a lens to understand, in detail, the formation of platform ecosystems that sustain the current digital economy.

Relationships, complementarities, and boundary resources

The proliferation of fluid and complex relationships has dramatically changed the digital landscape since digital platforms began. Rather than being stand-alone organisations,

digital platforms are increasingly embedded in a complex web of commercial relationships that characterise the digital economy. Digital platforms today rely upon multiple relationships through which resources and services are produced, distributed and traded globally (Constantiou et al., 2017; Helmond, 2015; Mcintyre et al., 2020; Parker et al., 2016).

The value creation no longer resides in any one platform; instead, value is leveraged by the multiple relationships that the platform establishes within and across several business domain and industries. These relationships have been widely studied as structural and organisational configurations that sustain value creation in the ecosystem by procuring, producing, and exchanging various resources (Baldwin, 2019; Gawer, 2009; Henfridsson & Bygstad, 2013; Jacobides et al., 2018; Tilson et al., 2010; Tiwana et al., 2010; Yoo et al., 2010). However, these relationships can also constraint the creation of value (Cordella & Paletti, 2019).

Complementarities have arisen as a relevant concept in understanding ecosystems. Complementarities characterise the diverse relationships between actors within ecosystems and the ways such relationships are linked to value creation (Baldwin, 2019; Jacobides et al., 2018). Some type of complementarities acquires a greater value when used together, and other types of complementarities have no value if one is missed (Baldwin, 2019). Specific complementarities that entail mutual dependency in value creation tend to foster the emergence of ecosystems (Jacobides et al., 2018). However, neither ecosystems nor economic relationships are conceived spontaneously; instead, they are conditioned by modular and layered architectures (Jacobides et al., 2018; Yoo et al., 2010).

In a modular architecture, the components of a system maintain a loose coupling with other components (Baldwin & Woodard, 2008; Henfridsson, Mathiassen, & Svahn, 2014; Henfridsson et al., 2018). Modularity provides the structural condition in which to ease the reconfigure of the platform's components and thus adapt to changes in the platform's environment (Baldwin, 2019; Henfridsson et al., 2018). Modularity also eases the ability of and increases the opportunities for third parties to integrate their complementary components into the platform (Baldwin, 2019).

A distinctive characteristic of ecosystems is to provide a structure of relationships within which many diverse complementarities coexist and coordinate without hierarchical management (Jacobides et al., 2018). In this context, it is essential to understand the mechanisms that nurture such relationships and coordinate the actions of diverse actors (Baldwin, 2019; Kapoor, 2018). In digital platforms, the multilateral relationships between ecosystem's actors occur via standardised and open interfaces (Baldwin, 2019; Eaton et al., 2015; Gawer, 2014; Ghazawneh & Henfridsson, 2013; Henfridsson et al., 2014, 2018; Yoo et al., 2010). Interfaces provide the conditions to thrive the development of new products and innovation, as well as the integrate value-adding complementarities (Baldwin, 2019; Baldwin & Woodard, 2008; Gawer, 2014; Mcintyre et al., 2020; Yoo et al., 2010). Interfaces configure the arrangements of rules, protocols, standards, and software tools that control the fluidity of digital resources through various components, platforms and business domains (Eaton et al., 2015; Ghazawneh & Henfridsson, 2013; Um & Yoo, 2016). Digital platform literature has predominantly focused on boundary resources, the software tools and regulations, that serve as the interface between platforms and third-party developers (e.g. Boudreau, 2010; Eaton et al., 2015; Ghazawneh &

Henfridsson, 2013; Ondrus, Gannamaneni, & Lyytinen, 2015; Parker & Van Alstyne, 2018b; Wareham, Fox, & Giner, 2014)

Though boundary resources studies are unquestionably relevant, they do not account for a number of significant relationships that digital platforms form with external actors and technologies(Gawer & Cusumano, 2014; Gorwa, 2019; Mcintyre et al., 2020; Skog, Wimelius, & Sandberg, 2018). For instance, this approach leaves out the relationships that digital platforms maintain with networks of advertisers, data brokers or affiliated websites. In the same way, technologies such as widgets, social buttons, and web banners among others are scarcely taken into consideration. These technologies are relevant as they act as boundary resources by governing the exchange of digital resources across platforms. As such, the mechanisms and technologies that sustain the platform's relationships among diverse actors have not yet been fully explored (Mcintyre et al., 2020).

Although ecosystems and digital platforms are dynamic in nature, few scholars have studied the evolution of the relationships that sustain them (Eaton et al., 2015; Mcintyre et al., 2020). It has been stated that a digital platform can move from being a platform leader to becoming a third party complementor or vice versa (Gawer, 2014) but such a condition has not been fully examined. Besides, rather than being static, boundary resources are the result of disputes and negotiation between several actors in the ecosystem (Eaton et al., 2015). Given the fluid nature of a platform's relationships, it is necessary to give a more detailed account of their evolution.

Methodology

The previous section provides theoretical bases on which this research is found, as well as highlighting the research approach. This section presents the methodological underpinning of this research and the rationale of the choices embedded in this methodology. It starts by describing the ontological and epistemological scaffolding for this research. It follows a justification for using a qualitative, case study research approach. The section then presents a detailed description of the three stages of data collection and analysis: Pilot study, TripAdvisor's press release archive and the company's webpage snapshots archive. The chapter ends with a discussion of the techniques utilised to ensure the validity and reliability of the findings.

Ontology and epistemology

Ontological, epistemological, and methodological adoptions have an enormous implication in the way that the phenomenon is unravelled and understood. Ontology relates to what can be known and epistemology concerns to the nature of what constitutes knowledge (Lincoln & Denzin, 2000) The methodology has a close relationship with the ontology and epistemology as it is regarding how the research is conducted (ibid). Consequently, methodological adoption depends on the epistemological position adopted, which in turn depends on the ontological assumption embraced. In what follows, the ontological and epistemological underpinnings for this research is explained in detail.

This research proceeds under the umbrella of critical realism ontology that has had significant contributions in Information Systems (IS) field. This ontology provides a robust basis to better understanding social phenomenon in which technology is part of it (Faulkner & Runde, 2013; Mingers, Mutch, & Willcocks, 2013). Critical realism

emphasises an in-depth explanation and understanding of events and their underlying causes (Mingers et al., 2013). In keeping with this line of inquiry, this research aims to gain a deep understanding of what has caused the current embeddedness of social media platforms in the digital economy.

Critical realism ontology which holds that reality exists independently of the knower (Bhaskar, 1979, 1989, cited on Sayer, 2000). It considers that reality is stratified in layers; the real, the actual and the empirical (Mingers, 2004; Sayer, 2000; Smith, 2006). The real is what exists, and it comprises enduring mechanisms and structures. The actual is what exists in action as events, being manifestations of the mechanisms which underlie the real. The empirical is what people can experience, based on observable events. While the empirical is the only level which researchers can access by observing the events directly, the actual and the real levels can be accessed through retroductive reasoning which explains events by hypothesising mechanisms (Bhaskar, 1979).

Retroduction is an analytical and iterative process that starts by observing and engaging with events at the level of the empirical to derive hypothetical explanations of the phenomenon. Such explanations draw on a deep understanding of the events rather than a quantification of them. "What causes something to happen has nothing to do with the number of times we have observed it happening. Explanation depends instead on identifying causal mechanisms and how they work and discovering if they have been activated and under what conditions." (Sayer, 2000, p. 14).

Through retroduction, several potential causal mechanisms emerged from empirical observations that can explain the phenomenon. However, in order to establish that such

hypothetical mechanisms actually do exist, they need to be assessed by trying and eliminating alternative explanations (Mingers et al., 2013). In practice, this assessment can be executed by following four analytical steps, the DREI methodology (Bhaskar, 1979 cited on Mingers, 2004). *Describe* the events of interest; *retroduce* plausible mechanisms that explain the phenomenon; *eliminate* false hypotheses by confronting with the vast extent of empirical shreds of evidence; *identify* the correct mechanisms.

Mechanisms play an essential role in explaining phenomena in critical realism. Mechanisms indicate and describe the processes and the series of actions, events, and causal links by which social outcomes are brought about (Avgerou, 2013; Kallinikos & Constantiou, 2015). In this way, they are "sets of entities and activities that produce change from an initial state to observed outcomes" (Avergou, 2013, p.407). In keeping with this line, this study traced the series of actions, events and their connections that may explain the changes in social media platforms and explain their embeddedness in the digital economy.

While adopting a critical realist ontological perspective, this study also assumes constructionism in epistemology. A constructionism epistemology assumes that knowledge is socially constructed, meaning that individuals and groups are actively engaging in the construction of knowledge (Crotty, 1998). This epistemology does not imply that reality is subjected and not real (ibid). In this way, following a constructionism epistemology does not contradict or conflict with critical realism ontology. The thesis acknowledges that reality exists independent of human perceptions while recognises the relativism of knowledge as socially conditioned.

Research design

The research design involved a series of choices that go in line with the ontological and epistemological scaffold. This section explains the choices undertaken in this research and defends their usefulness for addressing the particular topic at hand. First, it explains why this dissertation required a qualitative research design. Second, it justifies the choice of case study among others and finally, the section set out the reasons for choosing TripAdvisor as the case study.

The choice of a research design relies strongly on the type of research questions that are posed. Since this study is asking explanatory 'How' questions, the interest is in garnering rich insights into social media evolution and its current fit in the digital economy. As such, the research follows a qualitative design.

Qualitative research is of specific importance under two circumstances. The first is when the phenomenon under study is in a new area of knowledge (Patton, 2002), as is the case with social media platform evolution (de Reuver et al., 2018). The second is when the study aims to advance analytical generalisations, as the research design needs to facilitate the exploration and expansion of theoretical ideas. The explanatory approach of this research justifies its qualitative design (Gerring, 2004).

There are several different types of qualitative research, this dissertation anchors itself in a case study. A case study researches a contemporary phenomenon where it is difficult to establish boundaries between the phenomenon and its context and control it by the researchers (Robson, 2011; Yin, 2009). Social media phenomenon fits to case study

definition well. It represents a contemporary phenomenon whose sophisticated machinery makes it difficult for researchers to have control over the phenomenon and context.

A case study has three advantages over other qualitative approaches that justify its choice for this research. First, a case study is an iterative process that contributes to developing a gradual understanding of the complexities of the phenomenon under study. This iterative process allows adjusting the research focus, data collection strategies or analysis if it is required (Eisenhardt, 1989; Yin, 2009). In the case at hand, the study comprises three phases: a pilot study, and the collection of digital records from two archives. The understanding gained during the pilot study caused the change of the research attention to the social media evolution. In so doing, data collection strategies shifted to collect longitudinal data from two archives.

Second, a case study gives access to multiple sources of empirical evidence to obtain a deep understanding of a contemporary phenomenon in its context (Flyvbjerg, 2006; Robson, 2011; Yin, 2009). In this fashion, this investigation relies on different sources (e.g. field notes, digital records), and gathers them with multiple techniques and methods. The systematic data collection allows for a detailed contextual understanding to emerge of social media's evolution and its current status in the digital economy. In addition, the multiple sources of data enhance the validity of the case by allowing the researcher to triangulate them.

Third, case studies make it possible to overlap the data collection and analysis, allowing the researcher to inductively moves between observing empirical evidence and developing potential theoretical explanations to the overall phenomenon (Eisenhardt,

1989; Yin, 2009). This allows the researcher to assess plausible mechanisms and eliminate alternative explanations, vital in critical realism (Mingers, 2002). Over time, these inductive processes establish converging lines of evidence and theoretical propositions concerning the platform's evolution. Analytic generalisations are not intended to infer from statistics to a population. Instead, they do base on a theoretical analysis in which empirical observations are comparing with pre-existent theory. Analytic generalisations produce theoretical/conceptual frameworks that provide insightful explanations of a complex phenomenon.

A case study approach is also warranted because of the technological nature of the subject at hand. As mentioned early, technology exerts an intrinsic structuring force by shaping the social actors' perception of events and circumscribe possible courses of action (Beyes et al., 2019; Kallinikos, 2009, 2011; Lessig, 2006; Swanson, 2020). This structuring force is highly specific to the technology. Thus, to study social media's evolution, the research design needs to address the technological operations specific to the platform. Only through a case study, can we understand the platform's constraints and malleability (Kallinikos, 2011).

With this understanding in place of why a case study approach is justified for this research, we must now look at why TripAdvisor constitutes an appropriate case. The construct validity derived from a case study is only as good as the case underlying it. Following on Yin (2009), the choice of TripAdvisor as a case study rests on three main criteria: representativeness, pioneer status, and convenience.

First, as the largest travel platform in the world (TripAdvisor, 2019) TripAdvisor has left an indelible stamp on the online travel sector. TripAdvisor's services rely upon users' participation who share their experiences, provide ratings, and comment on accommodations, restaurants, or tourist attractions around the world. By September 2019, TripAdvisor had over 830 million reviews and opinions, covering 8.6 million travel business globally, and its audience reached 460 million unique monthly visitors (ibid). In this way, it is clearly a representative case of social media platforms.

Second, TripAdvisor is also a pioneer. It was an early bird in adopting trendy social media functionalities (e.g. social buttons, personalisation) and more recently, traditional services (e.g. booking). In addition, TripAdvisor was one of the first social media platforms, it began approximately five years before Facebook.

Third, it is also convenient. The existence of public digital archives that document nearly two decades of TripAdvisor's history from its creation in 2000. These archives detail relevant events, services, operations and partnerships readily lend themselves to reconstruct TripAdvisor evolution.

Data collections and analysis

The previous section explains the rationale for choosing a case study research approach and TripAdvisor as a suitable case. This section describes the three major phases of data collection and analysis: an exploratory pilot study and two explanatory stages (see Table 1). The pilot study served to explore and test propositions loosely linked to some initial theoretical understandings of social media. This pilot study resulted in the modification of the original research questions. It also guided the data collection and analysis of both

explanatory stages. These stages draw on digital records from two archives: TripAdvisor media centre and the Wayback Machine. The empirical evidence from these two archives served to build a gradually understanding of TripAdvisor evolution.

Though this thesis presents the data collection stages sequentially, the two explanatory stages overlapped. The overlap occurred as empirical evidence, and analytical propositions were triangulated or explored in more detail in one of the digital archives. In what follows, each stage is explained in terms of its objectives, data collection and analysis.

<u>Pilot</u>

From the economic literature, we know that social media platforms act as multisided markets by bringing together different types of actors (e.g. consumers, resellers, producers, advertisers.) (Evans & Schumalensee, 2016; Parker et al., 2016). However, very little is known about how the platforms shape and frame the participations and relations of these actors, especially at the business side. Thus, the purpose of the pilot study was to understand better how TripAdvisor operates in the business side ecosystem (hotels, attractions and restaurants). Specifically, the objective was to gain insight into the business owners' role in TripAdvisor data operations.

To this end, direct observation and interviews were chosen as data collection instruments because they are useful to explore contextual conditions (Robson, 2011). Direct observation facilitated to observe the micro-level interactions between a social media manager and TripAdvisor platform in their daily lives without participating or interfering.

Semi-structured interviews allowed to have one-to-one discussions with business owners/managers, guided by a thematic structure. The research's theoretical frameworks and the insights gained from direct observation guided the construction of the topics covered in the interviews. However, a semi-structured interview is a medium that allows engaging in conversational interactions with a single interviewee. This flexibility facilitated probing follow-up questions about specific areas or issues risen in the course of the interview (Yin, 2009)

The participants of the pilot study were hotels, restaurants and attractions owners/managers who direct use TripAdvisor. Participants were recruited through a mix of mechanism. In the case of the direct observation, an informant referred to a small hospitality business. The company has two hotels and two restaurants, and they were among the TripAdvisor top five list in their destination. A digital marketing manager oversees the four businesses and is the one who uses TripAdvisor and other digital platforms such as Booking.com. The digital marketing manager was observed for two weeks and enabled to obtain detailed insights into what services TripAdvisor offers to hotels and restaurants.

Invitations to participate in the interviews were distributed among the top five businesses listed on TripAdvisor in touristic destinations. This selection was under the assumption that top businesses in touristic locations engage more actively with TripAdvisor. The invitation briefly described the research and interview objectives. If the participant were willing to take part, both the full research description and consent form were sent. In total, 15 semi-structured interviews were conducted face-to-face in the hotel, attractions or restaurant, and each interview lasted around 30 - 60 mins. Post-interviews, approximately

thirty minutes, was taken to write notes and highlight the primary impressions of the conversation. These annotations served as a starting point in the analysis.

The preliminary analysis unveiled a new business actor – Internet booking engines (IBEs) – by which TripAdvisor can offer bookings services to hotels owners. To grasp how the booking services work, additional data were gathered from several online public resources: TripAdvisor owner centre[3], TripAdvisor insights[4], IBEs TripAdvisor partners websites, TripAdvisor for Developers[5] and TripAdvisor annual financial report. The first three sources provided factual evidence of how business owners can be part of TripAdvisor booking services. These sources served to triangulate the evidence derived from both the direct observation and interviews. They also served to expand the understanding of the process that enable booking services.

TripAdvisor for Developers delivers technical descriptions of TripAdvisor APIs that rule booking data flows within the platform ecosystem. The financial reports gave an account since 2011 of the economics and strategies of TripAdvisor. This source helped to understand TripAdvisor business strategy and test rivals' propositions that may claim the TripAdvisor evolution responds merely them.

The analytical procedure was to write several narratives which were "simple pure descriptions" that helped me "to cope early in the analysis process" (Danermark, Ekstrom, Jakobsen, & Karlsson, 2002; Eisenhardt, 1989, p. 540; Robson, 2011). The thick

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[3] https://www.tripadvisor.com/Owners and https://www.tripadvisor.com/TripAdvisorInsights
[4] https://www.tripadvisor.co.uk/TripAdvisorInsights
[5] https://developer-tripadvisor.com

narratives unveiled an intricate inter-platforms ecosystem by which TripAdvisor has over the last few years provided booking options to the end-user. This undergoing transformation may denote a new identity in TripAdvisor's operations which highly rely on its ecosystem. In light of the pilot study, two-line of enquiries rose concerning how social media platforms achieved their current position, and how the platform's ecosystem emerged. These enquiries led to refining the research question and data collection strategy to understand the social media evolution by investigating TripAdvisor's operations over time.

First data collection: TripAdvisor press releases

The main objective of the first data collection was to reconstitute the relevant events in TripAdvisor's history. To this end, the research drew on data from TripAdvisor media centre[6]. This online archive comprises digital records from December, 7 of 2000 that provide a public account of events that have marked the platform over time. The archive has two major categories: "In the News" and "Press releases". The first category records news about TripAdvisor published in the media while the second category records press releases issues by TripAdvisor itself. The archive has recorded 3,944 press releases from 2000 until March 2019, the end date of the data collection. From these records, 1,809 are in English and is the main corpus for analysis and, ultimately, theory generation (Yin, 2009).

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[6] https://tripadvisor.mediaroom.com

Press releases from the early days of TripAdvisor are scattered and are only a few lines long. For this reason, two secondary interviews of Stephen Kaufer – who has been TripAdvisor CEO from its creation – complemented the data from press releases. The interviews provided information about how TripAdvisor initial operated, assisting in contextualising the first events in its trajectory. The first interview is in the book "*Founders at Work: Stories of Startups' Early Days*" (Livingston, 2007). The second interview is on the online book focused on the travel sector titled "*The Definitive Oral History of Online Travel*" (Schaal, 2017).

On a first read of the 1,809 press releases were classified according to their subjects, emerging three main groups: Roll-outs, partnerships, and acquisitions. Press release on roll-outs documents the features launched by TripAdvisor over time. Partnerships group accounts for the relationships established by TripAdvisor with heterogeneous actors throughout the years. Press release on acquisitions group serves to trace back TripAdvisor purchases strategy.

The analysis of **roll-outs press releases** constitutes the core of the paper one, and a detailed description of the analytical procedures are in Chapter 2: Methodology. The analysis was conducted under the assumption that social media are data-driven platforms (Alaimo & Kallinikos, 2017) that provide various services to diverse actors. The purpose of the study was to obtain empirical evidence to advance analytic generalisations (Yin 2009) related to TripAdvisor's services evolution. To do this, three analytical techniques were used: pattern matching, explanation building, and time series (Yin, 2009).

The roll-outs analysis generated four primary outcomes: thick narratives, a timeline of TripAdvisor's events, code periodisation, and co-term analysis. The last version of the narrative is 85 pages long. It describes in detail the features that TripAdvisor has launches over time. The narrative highlights services characteristics in terms of data linkages, end-user roles and business ecosystem actors. The timeline of roll-outs facilitates the chronological visualisation of features and services, giving a preliminary insight into TripAdvisor evolutionary stages.

To gain further insight into TripAdvisor periods, the section 'About TripAdvisor' at the bottom of the press release were analysed. The section provides a short description of how TripAdvisor describes itself. These sections were manually compared by an iterative reading to identify the patterns of TripAdvisor self-identification. It was initially identified eight different descriptions which then they were reduced to three more basic stages (see Appendix 1), considering the type of services that TripAdvisor offering during the given stage. These patterns were juxtaposed to the timeline that helped infer the three stages in TripAdvisor's evolution: search engine, social media platform and end-to-end services.

The code periodisation was the result of superimposing TripAdvisor's three-stages on the code structure. The code structure was the outcome of a thematic analysis of the roll-outs press releases by systematically line-by-line reading and categorisation of meaningful themes (Miles, Huberman, & Saldaña, 2014). The code periodisation sought to reveal the mains themes or semantic blocks that characterise each stage.

Co-term analysis – a text mining technique – enabled the visual overview of the discourse embedded in a corpus and discover the topical clusters. This analysis served to uncover the main topics present in each stage. The topical clusters were in line with the patterns of TripAdvisor's evolution identified through the thematic analysis. This co-term analysis thus served to triangulate and support the evolutionary patterns of TripAdvisor.

Partnership and acquisition (P&A) press releases were analysed together, and they constitute the core of the third paper. A detailed description of the analytical procedures is in Chapter 4: Methodology. P&A press releases document TripAdvisor agreements with third-parties. These descriptions include comments from both parties about the benefits of the agreement and a brief description of the companies. While roll-out analysis focused on TripAdvisor's technological features evolution, P&A analysis focused on understanding TripAdvisor's relationships with heterogeneous actors over time. The broader aim was to develop theoretical propositions on how technology shapes both the platform's relationships and ecosystem actors over time. The platform instrumentalised its relationships by boundaries resources mechanism; a techno-organisational means that governs and controls the ecosystem's resource exchanges (Eaton et al., 2015; Ghazawneh & Henfridsson, 2013).

P&A analysis main results were a typology of TripAdvisor's ecosystem actors, a thick narrative and time-series visualisation of TripAdvisor's relationship dynamics. The typology served as a backbone to understanding the dynamics of actors and their relationship with TripAdvisor's overtime. To do this typology, first actors were identified from P&A press releases and annual financial reports. Actors were then classified by systematic reading of companies' description in the P&A press releases, companies'

website and well-known online publishers (e.g. Skift in the travel sector, TechCrunch in the technology sector). The result was a spreadsheet with four columns: the year when an actor was mentioned, actor name, actor description and actor type.

Following the typology, a thick narrative was written that focused on describing what happened in TripAdvisor's ecosystem in response to the development of new technological features. These events (new feature) were analytically decomposed into a combination of actors, relationships, and resource exchange rules. The narrative contains a depth description of the technological features (based on roll-outs analysis) and the changes in ecosystem configuration that they have brought. Types of actors mentioned in the roll-outs press release are a subset of P&A typology, covering only the type of actors who are directly linked with TripAdvisor features. That is why additional data were gathered (e.g. TripAdvisor's connectivity partners, financial report, TripAdvisor for developers) to enrich the narrative. The thick narrative provided a rich understanding of the dynamic nature of the relationships that TripAdvisor establish with its ecosystem.

The narrative though insightful lacks of enough contextual background on the reconfiguration of TripAdvisor's ecosystem. To this end, the alluvial time-series diagram was created to visualise the evolution of actors and relationships (Miles et al., 2014; Yin, 2009). The first step to create the alluvial diagram was to redefine the initial typology as the narrative brought a rich understanding of actors and their relationships with TripAdvisor. This refinement derived into 16 types of actors and 16 categories of relationships. The alluvial diagram linked years, type of relationships, and type of actors. This diagram thus helped to visualise TripAdvisor's relationship evolution and get insight into the reconfiguration of the TripAdvisor ecosystem.

<u>Second data collection: TripAdvisor end-user webpages interface</u>

The second data collection aimed to retrace the detailed fabric of technological-mediated operations that backed TripAdvisor's evolution by analysing the platform's webpages. This atypical data collection and analysis rest upon the idea that the platform's webpages can mirror some of the prominent operational transformations of a platform over time. This idea may be challenging as webpages do not entirely reveal or reflect the operational links across several layers of the platform under its surface. However, TripAdvisor's webpages have a central role as they are the means where core interactions occur, and a full range of services are offered. Given this central role, webpages can be considered windows to observe part of TripAdvisor's operations and faithful testimony of TripAdvisor's evolution. Thus, TripAdvisor webpages served to infer the platform core operations and reconstruct its relationships with other key actors in its environment.

Webpages are called natively digital objects, as they are native in a computing sense (Rogers, 2013). Webpages are arrangements of discrete digital objects that I called web object as they rest upon web technologies to exist. These web objects are the outcome of both complex technological operations and intensive overflow of data across distributed actors that serve to the platform strategies or objectives. These web objects also are basic objects embedded in a webpage with which users interact. Web objects can be as simple as the login button or complex as a list of recommended items. Webpages including web objects are not neural as they are actively conditioning interactions and information, shaping the nature of the user-platform interaction, practices and resources exchanges (Bucher, 2012; Faulkner & Runde, 2019; Shah, 2019). The specific objective of analysing

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TripAdvisor's webpages was to identify theoretical constructs and patterns of user-platform interaction and practices, as well as infer the platform's operational profile.

Chapter 3 methodology explains in detail the data collection and analytical procedures. The study drew on an extensive collection of webpage snapshots, retrieved from the Wayback Machine, a digital archive of Internet sites. The snapshots are webpages archived at a time point in the past, serving as public documents that account for TripAdvisor end-user interface transformations. The archive maintains 53,558 snapshots from 2000 until January 2019, the end date of the data collection. Two snapshots per day were retrieval (15,461), and they formed the empirical evidence for analysis and interpretation and, ultimately, theoretical proposition elaboration (Yin, 2009).

Due to webpages technological nature and volume, data collection and analysis were based on computationally intensive methods, also called digital methods. These methods are a mixture of manual and computational activities that have been used to study platforms such as Facebook, Twitter, Wikipedia (some examples in Berente, Seidel, & Safadi, 2019; Rogers, 2013). Digital methods rather than having standard procedures, they consist into adapting computational tools or technique to the research at hand (i.e. Research question, data). This study followed four major analytical steps to uncover patterns on TripAdvisor evolution gradually: sampling, taxonomy formation, pattern recognition, and data visualisation (Kitchin, 2014; Langley, 2000).

The first two steps served to explore the data set and have an initial insight into the undergoing transformation in TripAdvisor webpages. In the *sampling* step, webpages were selected, download and pre-processing to make them ready to manually analysis.

This step was supported by two Python programs especially coded to retrieval subset of webpages and compare them. The computational comparison of webpages' structures identified 2,863 different snapshots that were manually analysed.

The manual analysis results in a chronological sequence of the changes occurred on TripAdvisor's webpages. Three types of changes were identified. Fist, changes occurred by the launch of new features (e.g. users' reviews or Facebook login). Webpages with this type of changes were the basis for inferring changes on the technological-mediated operations and the role of TripAdvisor's ecosystem actors. Second, changes related to variations in the graphic style (e.g. colours, icons, fonts). Third, changes in the disposition of elements on the webpages (e.g. reviews were moved from the bottom to the top).

In the second analytical step, webpages snapshots with new features or elements were analysed in detail to develop a *taxonomy* of web objects embedded on TripAdvisor webpages. This taxonomy comprised two tasks. It was first identified the underlying structures in the webpages that endure (web objects). The 83 web objects were identified based on web objects' functionalities, sources of data, and practices. It was then inferred operational links across several layers of TripAdvisor that backed these web objects.

Though insightful, the taxonomy itself provides little understanding of the transformation occurred on TripAdvisor's webpages over time. Pattern recognition, and data visualisation, the two last analytical steps, contributed to this end. Both steps were supported by computational tools that facilitated the identification and visualisation of evolutionary patterns across the entire population of snapshots. A python program was explicitly coded to count the presence of web objects in each webpage and then calculate

the average of their presence per year. It followed to these calculations the data visualisation step that was based on generating streamgraphs.

Streamgraphs enhance the discovery of trends and patterns over time by displaying changes in values across a wide range of categories in a given period of time. In this study, several streamgraphs were generated using diverse categories. The one that used the web objects practices as categories resulted in being more insightful. The values were the average presence of web objects grouped by their underlying practice per year. This graph assisted in understanding the undergoing transformation of TripAdvisor web objects. It also served to infer the changes in TripAdvisor operational profile and the role of technology on it.

Quality and validity.

Case study research and qualitative research more broadly require a rigorous use of methods and procedures to ensure the quality and validity of findings (Yin, 2009). Validation, triangulation and thick narratives are criteria to judge the quality of qualitative research (Flick, 2006; Yin, 2009). To meet these quality criteria, this research followed three principles proposed by Yin (2009): use of multiple sources of evidence, establish a case study database and maintain a chain of evidence.

As mentioned, the research drew on six sources of evidence: 1) direct observation and interviews, 2) TripAdvisor's press release, 3) TripAdvisor's webpages snapshots, 4) two secondary interviews to TripAdvisor's CEO, 5) TripAdvisor's financial annual reports and 6) complementary public online resources. All these data maintained in a database separated by the stage of data collection (pilot, first and second data collection). In a

separate database, all the analysis conducted has been recorded (e.g. thematic analysis, narratives, co-terms analysis, visualisations).

To keep a chain of evidence, an identifier was assigned to each source of evidence. TripAdvisor's press releases identification is the date of publication and their title. Webpage snapshots identifications are the same used by the WayBack Machine archive. Findings use these identifications to trace back the empirical observations, at the same findings are tied to the research questions in each paper. Thus, this chain of evidence enables to trace in either direction from empirical evidence to research question.

Triangulation is especially recommended when data is collected by different methods (Robson, 2011), to develop convergent evidence (Yin, 2009). The research employed two types of triangulation: data and method triangulation (Patton, 2002; Yin, 2009). Data triangulation refers to confront different sources of evidence to confirm or discard findings. During the pilot study, observations derived from the direct observation, interviews and complementary documentation were confronted with each other. This triangulation confirmed the complexity of TripAdvisor ecosystem that sustain the platform. The findings emerged from the TripAdvisor's press release, and webpages snapshots were triangulated to confirm the evolutionary patterns that TripAdvisor present. Method triangulation refers to applying different methods of analysis to the same source of data. During the first and second data collection, this triangulation was applied. TripAdvisor's press release was analysed using thematic analysis and co-term analysis whose findings were triangulated and confirmed. In the case of TripAdvisor webpages snapshots, findings derived from the manual observation were triangulated with the streamgraph.

Overall, the combination of multiple sources and quality criteria enable the validity and

reliability of the findings and ensure a good understanding of the evolutionary patterns of

social media and the current status of embeddedness in the digital economy

Table 1. Research Design Summary

Stages	Pilot	1st Data collection	2nd Data collection
Objectives	To better understanding of TripAdvisor's operations in the business owner side	To reconstitution the evolution of TripAdvisor's services (paper 1) and relations (paper 3)	To reconstitution of low-level technological operations and user involvement (paper 2)
Data elicitation	In-person: semi-structured interviews and in situ observations Collection of online public resources: • TripAdvisor owner centre[7] • TripAdvisor insights[8] • IBEs TripAdvisor partners websites • TripAdvisor for Developers[9] • TripAdvisor annual financial report (9 reports from 2011)	• TripAdvisor media centre[10] (3,944 records from 2000 to March 2019) • TripAdvisor investor centre[11] (9 annual financial reports from 2011) • Two secondary interviews of Stephen Kaufer, TripAdvisor CEO from its origin	The Wayback Machine (53,558 snapshots of TripAdvisor website)
Data Analysis	Narratives.	Thematic analysis, narratives, digital methods	Digital methods, manual analysis of webpages and narratives
Output	Pilot analytical report	Code structures, code periodisation, thick narratives, three co-term network analysis	Chronology of webpages snapshots changes, and streamgraph
Quality criteria	Data triangulation (direct observation, interviews, and digital documents)	Method triangulation (thematic analysis & co-term)	Method triangulation (manual analysis & streamgraphs)
		Data triangulation (first data collection & second data collection)	

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[7] https://www.tripadvisor.com/Owners and https://www.tripadvisor.com/TripAdvisorInsights

[8] https://www.tripadvisor.co.uk/TripAdvisorInsights

[9] https://developer-tripadvisor.com

[10] www.tripadvisor.mediaroom.com

[11] http://ir.tripadvisor.com/investor-relations

Overview of the papers

The previous section outlines the methodology for this study. It explains the rationale behind the data collection and analytical procedures used in this research. This section provides an overview of the three papers that comprise this thesis. Together these papers contribute to enriching the understanding of the evolution of social media platforms, and their embeddedness in the digital economy. The papers offer different but complementary approaches. This section begins by explaining how the papers answer the thesis research questions and how they relate to one another.

As mentioned, the central question of this study is how social media platforms have evolved and become embedded in a web of commercial relationships that are characteristic of the current digital economy. The rationale of the thesis is to explore and advance theoretical ideas of how social media platforms have evolved that have scarcely been studied (de Reuver et al., 2018). The thesis pays close attention to the technological, organisational and economics configurations that underlie social media platforms' operations.

The first paper (Chapter 2) focuses on understanding the emergence of intricate techno-organisational structures that support and materialise a vast number of TripAdvisor's services. In particular, those structures that enable digital resources and data exchanges that sustain the platform's commercial relations with actors across diverse business domains. In social-oriented digital platforms, the user webpages interfaces play an important role as they are where core user-platform interactions occur, and a significant variety of services are offered. In this way, the second paper (Chapter 3) centres on investigating the evolution of the fabric of technologically-mediated operations that sustain essential user-platform interaction.

This thesis, in addition, seeks to uncover the underlying conditions that foster the formation of the social media platform's ecosystem and the current social media's embeddedness in the digital economy. In this fashion, the third paper (Chapter 4) investigates the evolution of the platform's relationships. In particular, it focuses on understanding the structural aspects and mechanisms that have, over time, shaped the platform's relationships with heterogeneous actors within and across diverse business domains.

Paper one: Platform as service ecosystems – lessons from social media

In the digital economy, data are an essential medium by which commercial connections are forged. Many contemporary services traded across platforms and ecosystems rely upon the intensive and dynamic computation of data overflow across several sources, organisations or platforms. Given the central role of data in social media platforms in particular (Alaimo & Kallinikos, 2017), this paper paid close attention of their role in the dynamics of social media platforms and the formation of platform ecosystems. At the same time, this paper examined the role of users, which is widely neglected when viewing social media platforms as merely economic entities. This paper and more broadly this dissertation regard social media platforms as organisational entities. This perspective aims to bring together the economic, technological and operational complexity of these platforms without side-lining the role of users who give social media platforms their distinct characteristic.

This paper, in particular, addresses the following questions: *How do data generation, flow and commercialisation drive ecosystem formation and account for the functional contribution data make to the emergence of ecosystem relationships?* As mentioned, the paper also looks at the role of users. The patterns of user participation that lead to data

generation is usually well studied. However, less is known about the mechanisms by which these data are brought to bear on business transaction data. To better grasp these mechanisms, the paper addresses the following set of questions: *How do outgoing links between different forms or types of data, shape platform evolution and the rise of platform ecosystems? What lessons can we draw from the study of TripAdvisor as regards the role of such diverse types of data and the links they occasion to play in ecosystem formation?*

The empirical evidence to answer these questions was drawn from the pilot study and the analysis of TripAdvisor press releases that documented the roll-out of new features. This paper retraces the patterns of the TripAdvisor evolution from its foundation in 2000 to 2019. Three stages in TripAdvisor's evolution are envisaged: its profile as a search engine, social media platform and end-to-end service ecosystem. Each stage is closely associated with a number of data types, technological functionalities, and actor configuration.

This paper increases our understanding of the transformation of social media platforms and their importance in the digital economy. It reveals the reciprocal relations that exist between data and technological operations that leveraged both the platform's expansion and the development of its service ecosystem. This study suggests that social media platforms embedded in the digital economy by developing both technological and organisational capabilities to exploit data systematically from dynamic and diverse sources to produce their services. In simple: no data, no services.

The close attention paid to technology, data and user configurations in the dynamic of social media platforms enables this paper to make relevant contributions of the existing theories of digital platforms and ecosystems. The paper expands the concept of data services and discusses the critical role of data as a dual entity. Data, on the one hand, are

a specific type of resource for the making of services. On the other hand, data are the medium through which social, economic and relationships are expressed and ultimately perceived. It also discloses the role of data and the technological conditions which form the basis for emerging multilateral commercial relationships. Data-made relationships, contrasting with those conditioned by physical resources, are highly reconfigurable and updatable. The nature of these relationships leads to constant redefining of the organisations and industries boundaries in many and unexpected ways. The new approach introduced in this paper provides a starting point from which to research the dynamics of digital platforms and ecosystem further.

Paper two: Patterns of digital transformation – a study of TripAdvisor

The previous paper tackles the thesis research question by examining the data arrangements that foster the evolution of TripAdvisor's services and the emergence of its ecosystem. This paper scrutinises the technological fabric by which TripAdvisor is able to offer its services. In particular, it approaches the dissertation research question by inquiring into the patterns of TripAdvisor evolution, and the way which TripAdvisor's operations respond to and co-evolve with technological change.

Digital platform operations strong intertwined with a range of technologies and the practices associated with their use and management. Rather than merely supporting pre-existing business objectives, these technologies are structuring forces that take part in the making of digital platforms. Technologies, on the one hand, equip the platforms with the functional conditions and the means through which their business objectives are instrumented and achieved. On the other hand, they shape the social actors' perception of events and circumscribe possible courses of action (Beyes et al., 2019; Kallinikos, 2009, 2011; Lessig, 2006; Swanson, 2020).

The technological fabric of digital platforms is typically studied from a macro perspective in the current literature by conceptualising technology mainly as architecture and infrastructure. Though these macro-level conceptualisations provide relevant contributions to the field, they are hard to relate to the platform's everyday operations. This paper accordingly proposes a shift to a much more granular level to unpack the detailed fabric of technologically mediated operations that sustain users-platform interactions. It focuses on the interaction dynamics between digital objects and the social and organisational conditions in which these objects are embedded. The paper assumes that digital objects are essential building blocks in the making of platforms, as well as being a significant factor in their status, identity and evolution within the digital economy.

The paper addresses the following research questions: *How do digital platforms organise and instrument their operations through the development and use of digital objects? How do such digital objects confer platforms their distinct identity?* These questions enquire into the evolution of digital platforms by critical examining the everyday operations that shape user-platform interactions. Furthermore, digital platforms' operations are intrinsically connected to technologies. To better comprehend the way in which platforms' operations evolve with technologies and their practices, the paper addresses the following question: *How are the design and use of digital objects linked to the technological dynamics and the evolution of the internet ecosystem?*

This paper reconstructs the operational evolution of TripAdvisor and draws on the empirical evidence resulting from the second data collection. Specifically, this paper meticulously analyses webpages' snapshots of TripAdvisor's from the company's foundation in 2000 through 2019 by using both qualitative and digital methods. This analysis identifies four distinct stages in TripAdvisor's evolution. Each stage denotes a

distinguishable blend of digital objects, data practices, economic operations and stylized form of user participation. The study implies that the platform's operational identity is the result of an intricate interplay of technology, actors, strategies, and relationships that influence and often reinforce each other.

This paper has several contributions to make to the existing theories of digital platforms and platforms' evolution. It provides a new theoretical lens by linking high-level explanatory concepts to lower-level technologically mediated operations that sustain the end-user interfaces. In this way, it reveals the role of diverse configurations of technologies, digital objects, roles, and practices in the platform attaining its status and identity in the digital economy. At the methodological level, this study of digital platforms is the first to draw on end-user interfaces as empirical evidence, providing a detailed insight into everyday operations. This paper also contributes by revealing the importance of end-user interfaces for core interactions between users and platform, which, in turn, assist in the making of the digital platform's identity.

Paper three: Boundary-making in platform ecosystems – the case of TripAdvisor

This third paper takes a different angle to tackle the thesis research question compared to the previous ones. The first one studies the evolution of social media platforms by studying data services and the ecosystem formation; the second one the technological fabric that supports the platform's everyday operations. This one focuses on studying the role of technology in the dynamics of the platform's relationships with heterogeneous external actors.

The rapid expansion of webs of commercial relationships within and across diverse business domains forms a pillar of the digital economy. These relationships have been

widely studied as the structural and organisational configurations that sustain value creation in the ecosystem by procuring, producing and exchanging various resources (Baldwin, 2019; Gawer, 2009; Henfridsson & Bygstad, 2013; Jacobides et al., 2018; Tilson et al., 2010; Tiwana et al., 2010; Yoo et al., 2010). Such relationships have blurred the boundaries of digital platforms, renewing interest in understanding how relationships evolve and enable organisations to benefit from external resources and still maintain their autonomy from external influences (Aldrich, 1979; Santos & Eisenhardt, 2005; Scott, 2008; Thompson, 1967). However, these relationships among diverse actors in the platform ecosystem do not occur *ipso facto*. They are sustained by intricate techno-organisational configurations (i.e. APIs[12], SDKs[13], protocols, standards) which allow digital assets to flow through various components, platforms and business domains.

The literature on digital platforms and platform ecosystems predominantly has studied relationships between platforms and third-party developers or complementors. This focus gives only a partial view and overlooks a number of other relevant relationships with external actors and technologies (Gawer & Cusumano, 2014; Gorwa, 2019; Skog et al. 2018). For instance, this approach leaves out the relationships that digital platforms maintain with networks of advertisers, data brokers or affiliated websites. In the same way, technologies such as widgets, social buttons, web banners among others are scarcely taken into consideration. These technologies are relevant as they act as boundary resources by governing the exchange of digital assets across platforms. Seen against this background, this paper investigates a broader spectrum of technologies whereby digital

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[12] Application Programming Interfaces
[13] Software Development Kit

platforms coordinate and control their relationships and the exchange of resources with heterogeneous actors.

The central research questions that concern this paper are: *How do technologies shape both the drivers and mechanisms of boundary-making?* Technological advances unquestionably shape the digital world. Many of these technologies have likely fostered the forging of new relationships in the digital economy. However, little is known about the role of technology in forging ecosystem relationships. Though the fluid nature of these relationships is known, their evolution remains untheorised. To unpack this evolution, this paper tackles the following question: *How do technologies shape and reconfigure relationships, actors and roles?*

This paper draws on the analysis of the first data collection to address these research questions. This paper's primary data are TripAdvisor press releases that document significant events in its history from its inception in 2000 through 2019. The study uncovers several mechanisms of boundary-making (i.e. partnerships, acquisitions, commercial agreements, "plug-and-play" solutions) by which TripAdvisor has been able to establish, govern and enlarge its now vast ecosystem. It suggests that technologies have a dual role in shaping the drivers and mechanisms of boundary-making. Technologies not only govern the exchange of resources in the platform's ecosystem, but they are themself essential resources of exchange. The paper also accounts for three distinctive ecosystem configurations in terms of actors, roles and rules during almost two decades of TripAdvisor's history.

This paper contributes to existing theories by expanding the understanding of boundary-making and boundary-resources in digital platform ecosystems. It indicates that technologies have a more significant role in influencing both the drivers and mechanisms

of boundary-making than that is currently credited in the existing literature. Further, this study contributes to understanding the evolution of platforms' ecosystem by examining the important role played by technology in shaping the configuration of relationships within digital ecosystems.

Chapter 2

Platforms as service ecosystems: Lessons from social media

Abstract

The growing business expansion of social media platforms is changing their identity and transforming the practices of networking, data and content sharing with which social media have been commonly associated. We empirically investigate these shifts in the context of TripAdvisor and its evolution since its very establishment. We trace the mutations of the platform along three stages we identify as a search engine, social media platform and end-to-end service ecosystem. Our findings reveal the underlying patterns of data types, technological functionalities and actor configurations that punctuate the business expansion of TripAdvisor and lead to the formation of its service ecosystem. We contribute to the understanding of the current trajectory in which social media find themselves as well as to the literature on platforms and ecosystems. We point out the importance of services that develop as commercially viable and constantly updatable data bundles out of diverse and dynamic data types. Such services are essential to the making of the complementarities that are claimed to underlie ecosystem formation.

Keywords: *Digital platform, platform ecosystem, data, data-based services, complementarities, social media, social networking, user participation*

Introduction

Since their inception, social media platforms have been bound up with the role of users as active platform participants. User-generated content has been emblematic of social media. YouTube, Facebook or Instagram are prominent examples that attest to the importance that large populations of users and their practices of networking, content

creation and sharing have had for social media. It is hardly surprising, therefore, that user involvement has figured as a defining attribute of social media across various literatures (see, for example, boyd, 2015; boyd & Ellison, 2008; Oestreicher-Singer & Zalmanson, 2013).

Justified as it may seem, the focus on users has nonetheless tended to downplay the structural, technological and economic forces that have driven the evolution of social media to complex and operationally diversified business actors. The contrast has become even more pronounced over the last few years as a result of the expansion of the commercial operations and industry involvement of key social media players. Facebook, for instance, has introduced payment services via Facebook Messenger and is now about to introduce its own cryptocurrency. LinkedIn has steadily extended its networking capabilities to the provision of talent and recruiting services to organizations, and TripAdvisor has begun to sell travel service packages across the entire holiday value chain, allowing users to review but also compare accommodation or restaurant information and make their booking. These developments provide alternative revenue sources (revenues from direct service charges in the case of LinkedIn and commission revenues in the case of TripAdvisor) to advertising that has been the dominant business model for a great deal of social media platforms. Critically, such changes expand, diversify and restructure the flows of data on the basis of which social media operate as economic organizations. Data from business transactions are added on and variously complement data derived from user interaction that for years have marked social media platforms.

It is hard to tell whether these developments reflect wider changes in the digital economy or are just symptomatic of a limited group of social media companies. Yet, on many signs

to judge (e.g. Facebook or LinkedIn's commercial growth and diversification), they are indicative of wider transformations. The study of TripAdvisor we report in this article suggests that these developments are associated with the growing involvement of the platform within a larger business ecosystem of diverse services. We deploy the concept of ecosystem to refer to the synergies and complementarities achieved between the activities, resources or outputs of several organizations. Such synergies and complementarities are portrayed in the literature as being resource or service specific in ways that strongly reinforce the value or returns of ecosystem participants (Adner, 2017; Jacobides et al., 2018; Teece, 2018). Ecosystems emerge around specific, value-reinforcing activity and resource complementarities that usually cut across several organizations, industries and platforms.

Building on and extending the current literature, we consider digital data (hence data) as central to the dynamics of social media platforms and essential to understanding their ongoing passage to platform ecosystems. This is an argument that takes the significance of data and their economic impact well beyond big data or big data analytics (Kallinikos & Constantiou, 2015). Data, we suggest, are an essential and specific type of resource whose value is contingent on its constant updatability, portability and sharing (Kallinikos, 2007), attributes that require new practices of collaboration across boundaries (Arthur, 2017). But data are also a key medium by which business relationships and connections are forged in the digital economy. Many contemporary services traded across platforms and their ecosystems are data made or data underwritten. Such services are essentially data relations. Hotel popularity indexes, hotel room or restaurant table availability on real-time are typical examples. Data services of this sort are indexes and measures achieved by the computation of steadily updatable data, collected, aggregated and mashed up along paths that cut across several sources, organizations or platforms. Hence, we aim at

investigating how different kinds of data are drawn upon to establish the type of resource links and service complementarities that underpin ecosystem formation. Specifically, we ask, how do data generation, structuration and commercialization drive ecosystem formation? We know that user-generated content, social and networking data play a key role in sustaining social media platforms (Helmond, 2015; Oestreicher-Singer & Zalmanson, 2013; Van Dijck, 2013). Yet, very little is known about the dynamics by which such data are linked to business transaction data. How do the links between different types of data look like and how do they shape new economic practices, platform evolution and the formation of platform ecosystems?

We seek to address these questions through a longitudinal case study of TripAdvisor (Akemu & Abdelnour, 2018; de Reuver et al., 2018). The study retraces the pattern of transformations the platform has undergone from its establishment onwards along three major stages: search engine, social media platform and end-to-end service ecosystem. Each stage is linked to several data practices whereby specific data types and formats are produced, combined and used. In turn, such data practices are sustained by distinct platform functionalities. Data and functionalities are instrumental to the design and implementation of the various roles actors take and are made to perform as users on the platform, that is, end-users switching between producers, reviewers and consumers of data services or hotel owners acquiring an active role as subscribers of TripAdvisor's services.

The findings from the study of TripAdvisor have relevant implications for understanding how social media platforms are transforming into service ecosystems. In line with previous studies, we find that ecosystem formation is driven by the achievement of specific and value-reinforcing complementarities across several ecosystem participants

(Adner, 2017; Jacobides et al., 2018). In contrast to previous research, we find that such complementarities are often achieved by the systematic exploitation of different types of data which are drawn upon to assemble more complex data services (popularity index, booking packages, data analytics subscriptions, etc.). Data-based complementarities are established by the practices of data and data service generation and exploitation, the functionalities underlying these practices and the technologies and systems that support service exchanges. This implies that this type of service ecosystems, which are dependent on the practices of data complementarities, will be more likely to overwrite physically embedded and other types of constraints and to lead to cross-industry ecosystem emergence and innovation (Kallinikos et al., 2013; Yoo et al., 2010).

We contribute to the literature by tracing the development of data-based services and their role in establishing data complementarities, which we define as a specific type of data synergies that lead to the emergence of service ecosystems. Our study contributes to understanding the mutations social media currently undergo and has important implications for the study of digital platforms and digital ecosystems. The study suggests that successful social media platforms fashion complex and constantly shifting data services out of the diverse and dynamic sources of data they are able to produce or to get from partners. Complex data-based services are likely to require complementarities that give rise to business relationships which eventually lead to the emergence of ecosystems across organization, sector or industry boundaries.

The article is structured as follows. In the next section, we review the literature on social media, online platforms and ecosystems. We position ourselves vis-a-vis this literature and expose the issues we feel may require further attention and research. We subsequently present our case study of TripAdvisor. After outlining our research methodology and

describing our data collection and analysis, we move on to reconstructing at some length the evolution of TripAdvisor from a travel search engine to a central actor of the global travel and hospitality industry. We subsequently analyse our empirical narrative and place the evolution of the platform against the broader framework of the issues presented in our literature review and the wider literature on platforms and ecosystems and delineate our contribution to that literature. We conclude by a brief note on the wider relevance of our findings.

Literature review and positioning

Since their emergence, social media have been widely perceived as sites of networking and community building and, accordingly, referred to as social networking sites. The term carries the heritage of the early years and the perception of social media as predominantly online spaces of individual self-presentation and networking. Increasingly, such a view has been complemented by the understanding of social media as complex arrangements of actors, technologies and practices (Helmond, 2015; Srnicek, 2017; Van Dijck, 2013). As it now stands, the literature on social media spans over a large and cross-disciplinary landscape, extending from networking sites to platforms. While an exhaustive review of that literature is beyond the scope of this article (see, for example, de Reuver et al., 2018; Helmond, 2015), we outline below what we take to be the most representative perspectives on social media against which we position our research.

The first perspective we outline frames social media as social networking sites. It sees the emergence of social media as being closely associated with the establishment of a new paradigm of technology-mediated interactivity (boyd, 2015)[14] brought about the

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[14] What is often referred to as Web 2.0

transformation of the Web from a space of information display to an interactive environment in which users are able to act upon, create, share and modify content (Zittrain, 2008). The initial definition of social media as *social networking sites* is indicative of the understanding of social media as online facilities through which people link and interact with one another (e.g. boyd & Ellison, 2008; Ellison and boyd, 2013). The perspective stresses the centrality of social media users and focuses on the social, personal and political conditions underlying the morphing of groups, communities and networks online.

The conception of social media as sites of networking is obvious and, in a certain sense, hard to dispute. If there is anything distinctive with social media, then this pivots around the massive presence of users, and the shifting networks or communities that emerge (and dissolve) as users create, share and consume content online (Berger et al., 2014; Kane et al., 2014; Shirky, 2008). While germane, such focus overlooks the structural, technological and economic forces that shape the morphing of user networks and, ultimately, the behaviour of users (see, for example, Alaimo & Kallinikos, 2017, 2019a). The rapid development of data handling technologies, recommender systems and machine learning have transposed the ubiquitous interactivity of social media upon a technological context in which backend technologies and their links increasingly erode and considerably shape interaction patterns at the frontend.

The growing economic involvement of social media has furthermore put their conception as sites of conviviality and networking under a hard test. A great deal of social media sites has, over time, grown to complex and operationally diversified business actors. In the second perspective we outline, these developments have been gradually associated with the understanding of social media as platform organizations facilitating certain kind of

exchanges. In the wake of Rochet and Tirole's (2003, 2006) pioneering work on two-sided markets, online exchange facilities of this sort have been conceived as *multi-sided markets*. It is characteristic of such settings that the benefits of each group of participants on each side are contingent on the other side(s) by what is often referred to as indirect or cross-side network effects (Parker et al., 2016). This two-way interdependence constitutes multi-sided platforms as a distinct type of digital intermediaries and confers value to the role of intermediation they perform (Rysman, 2009).

The notion of multi-sidedness is a useful lens to approach social media as digital platforms and to study how the various types of stakeholders interact with one another in ways that benefit themselves and the platform owners. The mutual relationship between different sides is particularly valuable for multi-sided markets and is often perceived in terms of indirect or cross-side network effects (Boudreau, 2010; Evans & Schmalensee, 2005, 2016; Parker et al., 2016). Such an outlook confers a novel understanding of the economics of social media, yet it tends to subsume social media platforms under the more general category of digital platforms without regard for what might be the distinctive attributes of social media. The role of users as active generators of content and data, for instance, is seldom acknowledged. User data, their economy and their specific contribution to sustaining the operations of social media are often lost from sight. Digital platforms, we suggest, are more than marketplaces, and their operations are considerably shaped by cultural and technological forces.

The two perspectives outlined so far largely relegate technology to the background of social media operations. A third approach to digital platforms sees them as *technological infrastructures* or assemblages of various technical components (e.g. Helmond, 2015). Similar to other complex socio-technical systems, social media are sustained as entities

by a number of technologies and technologically attuned operations that are held together by a variety of technical links and architectures. The activities of users or platform participants on social media are conditioned by the interdependence of these technologies and organizational capabilities into a dynamic and reasonably functioning whole. Most social media are known to maintain complex data management systems through which data are standardized, structured and made portable within and across platforms and a large portion of the Web (Alaimo & Kallinikos, 2016; Gerlitz & Helmond, 2013). These operations, in turn, require suitable user interface designs to foster specific forms of user participation and a range of data management tools (e.g. recommender systems, data analytics) that considerably impact upon the behaviour of users or platform participants (Alaimo & Kallinikos, 2017, 2019b; Van Dijck, 2013).

Infrastructural conditions, therefore, carry important implications with respect to how platforms operate (see, for example, Contini & Lanzara, 2009; Hanseth & Lyytinen, 2010). Yoo et al. (2010), in particular, conceive of business relationships in the current digital world as conditioned by modular and layered technological architectures. As distinct from integral and often physically embedded architectures that feature links between the constitutive components of a system that are hardly decomposable (Ulrich, 1995), modularity and layering loosen component interdependencies (Baldwin & Woodard, 2009; Henfridsson et al., 2014, 2018) and allow recombinant innovation along several paths. These infrastructural conditions help establish a dynamic space of action and innovation whereby platform components can be brought into revisable configurations that render them able to respond on a constant basis to the shifting demands of the broader platform environments into which they are embedded (Baldwin & Clark, 2000; Henfridsson et al., 2018; Zittrain, 2008).

A final stream of research we consider is on platform ecosystems. The concept of *platform ecosystem* or simply *ecosystem* has become increasingly used over the past few years as a means of accounting for the advantages conferred to ecosystem participants by resource or activity links that cannot be attributed to standard supply chain con-figurations or other resource and action interdependencies associated with the concept of industry, cluster or network (Adner, 2017; Gawer, 2009, 2014; Langlois, 2003). Such links have become widely diffused in the digital economy, calling for an explanation of the forces that govern their establishment, development and eventual decline. Social media platforms and the apps they host are a case in point (Nieborg & Helmond, 2018). The concept of ecosystem and the study of the forces that underlie its formation emerged in this context as a way of pursuing questions that cannot be addressed by recourse to the conceptual tools associated with industry dynamics and the analysis of supply chain networks.

Adner (2017) defined an ecosystem as the formation of multilateral links on the input, activity or output side that are not attributable to the sum of bilateral associations between the participating actors. Thus viewed, an ecosystem is more than the sum of the bilateral business relationships in a network of firms. This *ecosystem-as-structure* perspective, as Adner calls it, contrasts with the view of ecosystems as networks of affiliated organizations. From this perspective, an ecosystem is the organic pattern of multilateral connections between firms and their activities that fosters synergies and complementarities that would otherwise not emerge. The concept of complementarities is particularly relevant here as it explains the formation of ecosystems. Jacobides et al. (2018) attribute ecosystem formation to the structure of complementary roles, resources and activities between a group of firms. Similar to Adner (2017), Jacobides et al. (2018) consider such complementarities as non-reducible to bilateral business relationships. Ecosystem-conducive complementarities develop as the result of unique or specific links

between several firms and are thus different from generic complementarities that do not require specific coordination mechanisms and have, under normal circumstances, been handled well by the market. It is the nature of specific complementarities entailing relationships of the type 'more of A makes B more valuable' and vice versa that tends to lead to ecosystem formation (see Jacobides et al., 2018). In simpler words, it is the strength, dynamicity and specificity of complementary relationships on the input, activity or output side that lead to ecosystem formation. The literature on ecosystems is much more diverse with reference often to platforms as the focal actors around which complementary relations between the core of the platform and its peripheral components, activities or resources develop (see, for example, Boudreau & Jeppesen, 2015; McIntyre & Srinivasan, 2017; Teece, 2018; Tiwana et al., 2010; Wareham et al., 2014). However, the arguments put forward by Adner (2017) and Jacobides et al. (2018) express much of the *geist* of current research on ecosystems.

There is still very little on the literature of ecosystems about social media. It can be conjectured that the ideas of specific and value-reinforcing complementarities across a group of components, services or firms are directly applicable to their case, but this is far from clear. The same, by and large, applies to the other two strands of literature that deal with digital platforms as multi-sided markets or infrastructures. Occasional references to social media across these literatures indicate they are often seen as particular instances of the wider phenomenon of digital platforms. By subsuming the specific phenomenon of social media under the more general category of digital platforms, much is gained but much is lost as well. The specificity of social media is compromised, and so are the ways by which users are involved in the creation and diffusion of content, the generation of data and the shaping of social media platforms more generally. Neglect of data and the technologies by which they are sustained is common to management and economics from

which two strands of the literature reviewed above emanate, that is, digital platforms as multi-sided markets and platform ecosystems. However, it applies as well to the other research strands we briefly reviewed in this section, namely social media as networking sites and, surprisingly, platforms as infrastructures. While the literature on platforms as infrastructures has produced unrivalled explanations on how component architecture matters (Henfridsson et al., 2018; Rolland & Monteiro, 2002; Yoo et al., 2010), the distinction between data and the technologies by which they are produced has remained often lurking and, thus, untheorized in this literature. Table 2 summarizes the four stands of literature reviewed, their primary focus and the key concepts they use.

Table 2. Different approaches to social media and digital platforms.

	Social media as networking sites	Platforms as multi-sided markets	Platforms as infrastructures	Platforms as ecosystems
Focus	User networks	Exchange mechanisms	Component links and architectures	Input, activity and output links
Key concepts	Network formation, user-generated content	Network effects markets and platforms	Modularity, core and periphery relations	Ecosystem structure and complementarities

We consider data as central to understanding the dynamics and specificity of social media platforms and the ecosystems in which they are embedded. Theorizing data and the critical role they play in shaping the current digital economy represents a major intellectual challenge. Similar perhaps to money, data are a dual entity. They are a specific kind of resource for the making of services but also the medium through which social, economic and material relationships are expressed and ultimately perceived. Reputation metrics, popularity or trending metrics are typical examples. Cast in this light, many contemporary services are data mediated, data made or data underwritten. By the same token, a great deal of the input and activity complementarities discussed in the case of the ecosystem literature are essentially constituted as data resource or data activity links. For instance, the complementarity developed across TripAdvisor and The Fork (a restaurant-

booking platform) are data links underwritten by the data resources by which they are described (reviews/ratings on TripAdvisor linked to restaurant availability and price comparisons). Certainly, data services, resources or activities have at some point to enter the physical, social or economic world and be redeemed by the consumption or use of physical resources such as hotel rooms and restaurant food. At the same time, it is important to realize that TripAdvisor, as many other social media platforms, does not trade physical products or resources but the availability of these products or resources (data) and their conditions such as prices, location and reputation (again data or metadata). All the services offered by these platforms are made possible by the standardization and computation of data collected, aggregated and mashed up along the data value chain (Alaimo & Kallinikos, 2017, 2019b).

We assume that social media platform evolution is significantly shaped by the development of the ecosystem within which platforms are embedded and, particularly, by the *structure of resource* and *data links* underpinning the relationships of ecosystem participants. The structure of links is, in turn, fashioned by the *technological systems* and the wider technological *infrastructures* underpinning ecosystem exchanges and operations (e.g. Yoo et al., 2010). Understanding the structure of links in the case of social media further requires charting the *models of user involvement* and the critical roles users play as *content* and *data generators* together with the technologies that support that goal (e.g. Alaimo & Kallinikos, 2016, 2017, 2019b; Gerlitz & Helmond, 2013; Helmond, 2015). Building on and extending the literature reviewed, we aim at investigating how different forms of data are drawn upon to establish the links that underpin ecosystem formation. Specifically, we would like to understand how data generation, flow and commercialization drive ecosystem formation and account for the functional contribution data make to the emergence of ecosystem relationships. The role user-generated content,

social and networking data play in sustaining social media platforms is generally well researched. However, less is known on the mechanics by which such data are brought to bear on business transaction data. How do these emergent links between different forms or types of data (e.g. transaction and user-generated data) shape platform evolution and the rise of platform ecosystems? What lessons can we draw from the study of TripAdvisor as regards the role such diverse types of data and the links they occasion play in ecosystem formation? Ultimately, do such developments drive social media platforms away from their reliance upon data traditionally derived from practices of networking, content generations and sharing?

Research design and methodology

We conducted a case study of TripAdvisor, from its establishment in the year 2000 to the end of 2017. Our ultimate research objective has been to use the empirical evidence as the basis for advancing *analytic generalizations* (Yin, 2009)[15] on the patterns of social media evolution and ecosystem formation. The case study consisted of two stages (see Table 2). The first stage is a pilot study of seven hotels, five restaurants and three attractions working with TripAdvisor. The study lasted four months and was conducted in 2017. The second stage entails the longitudinal study of TripAdvisor, mostly based on online, publicly available archival records (Rogers, 2013).

The pilot study has had a decisive impact on our continuing involvement in the field. It revealed the immense complexity of TripAdvisor's ecosystem and underlined the need to

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[15] Yin (2009) contrasts analytic generalization to statistical generalization. In this latter case, sampling decisions are critical to ensure representability and extrapolation of findings to the entire population. Analytic generalization is not about statistical representability but empirical relevance to a construct or theory that is usually achieved by the proper design of either case studies or experiments. Not surprisingly, thus, a single case study or experiment can test and elaborate an existing theory and occasionally develop an entirely new theory (see also Goodman, 1978)

study the data flows that underpin that ecosystem. For instance, booking a hotel room may seem a very simple and straightforward action. Yet, displaying real-time room availability of hotels distributed over the globe and being able to efficiently support the massive amounts of bookings arriving every minute is anything but simple. In this regard, the pilot study revealed portions of TripAdvisor's hidden ecosystem, the network of Internet Booking Engines (IBEs) through which room availability and booking are sustained as well as the complex data flows and revenue streams taking place between ecosystem participants such as TripAdvisor, IBEs, Online Travel Agencies (OTAs such as Expedia or Priceline) and hotel owners (including global hotel chains such as Marriott or Hilton). Coupled with our critical review of the literature, the pilot reinforced the idea that social media companies are embedded in complex business ecosystems and made us sharply aware of the complexity of links underpinning the relationships of ecosystem participants.

The longitudinal study entailed the collection of evidence from the TripAdvisor media centre (see Table 3). While certainly linked to the public image TripAdvisor may wish to convey, these records are factual enough and inherently not worse in quality than evidence collected through interviews, minutes and documents. In fact, their public accountability makes them more rather than less reliable. The section 'Press releases' was particularly relevant for our study as it provided first-hand, factual information about the course of events that have marked the evolution of the platform over time. Data collection was complemented with two secondary interviews of Stephen Kaufer, TripAdvisor CEO over the years[16]. It is a diffused practice in case study research to use biographies or other

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[16] The first interview is published in the book *Founders at Work: Stories of Startups' Early Days* (Livingston, 2007). The second interview is on the online book titled *The Definitive Oral History of Online Travel* (Schaal, 2016).

material such as public interviews to reconstruct historical evidence (Weick, 1993). The interviews provided information on the early stages of TripAdvisor, which is hard to find and helped us contextualize the data from our online sources.

Table 3. Data stages and sources.

	Data sources
Pilot case	15 semi-structured interviews
	10 days of in situ observations
	Documents and videos:
	1. TripAdvisor insights (www.tripadvisor.com/TripAdvisorInsights)
	2. TripAdvisor business owner websites (forums, articles, tutorials, etc.), TripAdvisor For Developers (https://developer-tripadvisor.com), including API technical description
	3. TripAdvisor's connectivity partners, websites freetobook, travelclick and sabre
	4. Annual financial reports of TripAdvisor
Longitudinal case	TripAdvisor media centre (https://tripadvisor.mediaroom.com)
	'Press releases': 3388 press releases from 2000 until December 2017. 1677 of these records are in English and make the primary information source of this case narrative
	Two secondary interviews of Stephen Kaufer, TripAdvisor CEO over the years

The 1677 press releases in English were classified according to their content: rollouts, partnerships, acquisitions, awards and reports. While we base our report on the entire archive, the rollouts sub-category (216 publications) has played a crucial role as it provided most of the evidence of the features launched over time, which is key to understanding the transformations of the platform. The 216 rollout press releases were manually analysed in two consecutive cycles: codes and coding, and pattern codes (Miles et al., 2014). Under the assumption that social media are data platforms (Alaimo & Kallinikos, 2017) that provide services, the categories *data production* and *services* were set as the default themes on the basis of which the coding process was conducted. Through iterative line-by-line reading, cross-checking and juxtaposition, chunks of text were assigned descriptive labels ('codes') which were then grouped into meaningful categories and themes. A new overarching category, that is, *ecosystem*, emerged out of this process (see Figure 1).

Although this analysis allowed us to extract themes from the data corpus, it did not provide us with a timeline of events. For this, we relied on a subsection found at the bottom of most of the 1677 press releases, entitled 'About TripAdvisor', where the company describes itself over the years. We tracked changes in this section manually, which resulted in the identification of eight initial patterns that, through iterative readings and theme comparisons, were reduced to three more basic stages of development: (1) search engine, (2) social media platform and (3) end-to-end services. We superimposed this three-stage periodization (search engine, social media, end-to-end services) to the code structure of Figure 1. The results are shown in Figure 2 that maps the descriptive themes that emerged from coding on the temporal axis of the stages of TripAdvisor's evolution.
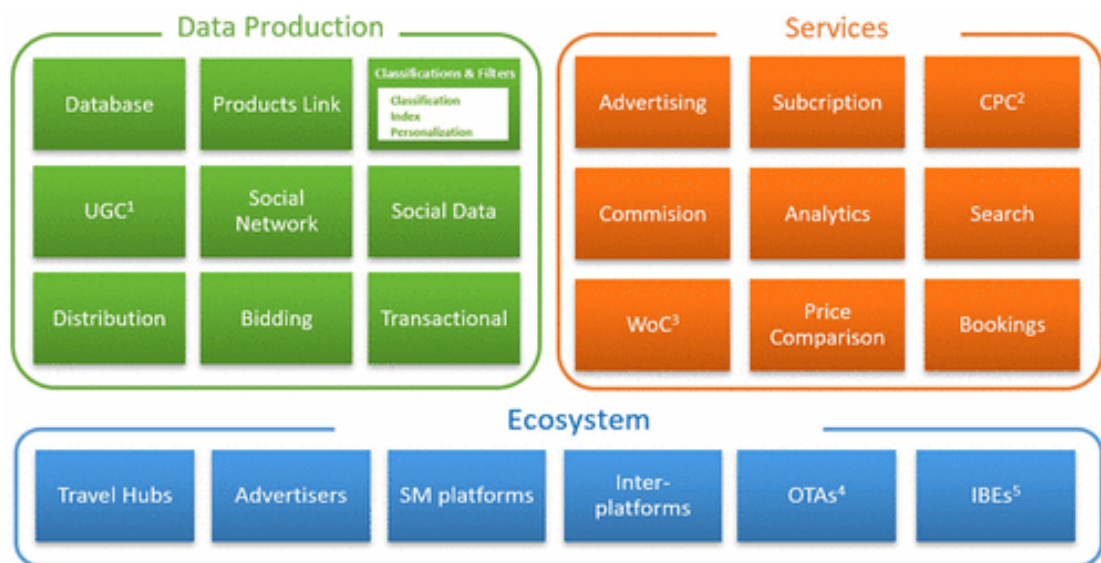
Figure 1. Code structure.

UGC: User-Generated Content; CPC: Cost Per Click; WoC: Wisdom of Crowd; OTA: Online Travel Agency; IBE: Internet Booking Engine
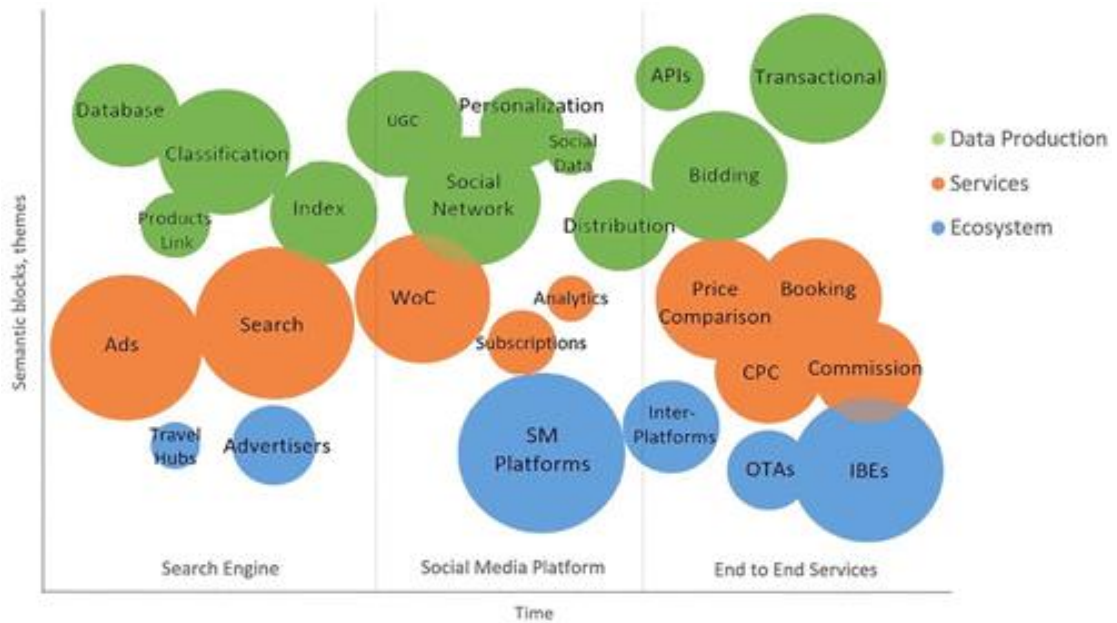
Figure 2. Code periodization.

We assessed and validated the thematic analysis with *co-term network analysis*, a text mining technique that facilitates uncovering hidden meaning patterns and structures embedded in a specified text corpus. This technique measures the frequency of appearance of terms in a text both in isolation and in conjunction with other terms. It provides an overview of the term structure and makes visible the clusters of topics embedded in a text corpus by aggregating the terms that are more densely connected.

The process of generating a co-term network analysis is semi-manual and involves several steps (see Figure 3). We used CorText, an online tool for text corpus analysis, to support the process. The co-term network analysis is a reductionist, bottom-up data process. It starts by building a dictionary with relevant terms. In our case, we built our dictionary based on the 300 most frequent two-to-three consecutive words that CorText identified in the corpus. These terms were manually cleaned by removing terms that did not contribute to the production of meaning (such as names). Also, terms with the same meaning were grouped together. For instance, among the top 300 most frequent terms appear "connectivity partners", "booking engines", "IBEs" and "TripConnect partners".

These terms in the text corpus are synonyms, and for this reason, they were subsumed under the same term (connectivity partners). The cleaning required understanding the meaning of the terms and context in which the terms appear to reduce the amount of noise without losing meaningful terms. This was essentially aided by the thematic analysis we outlined above.
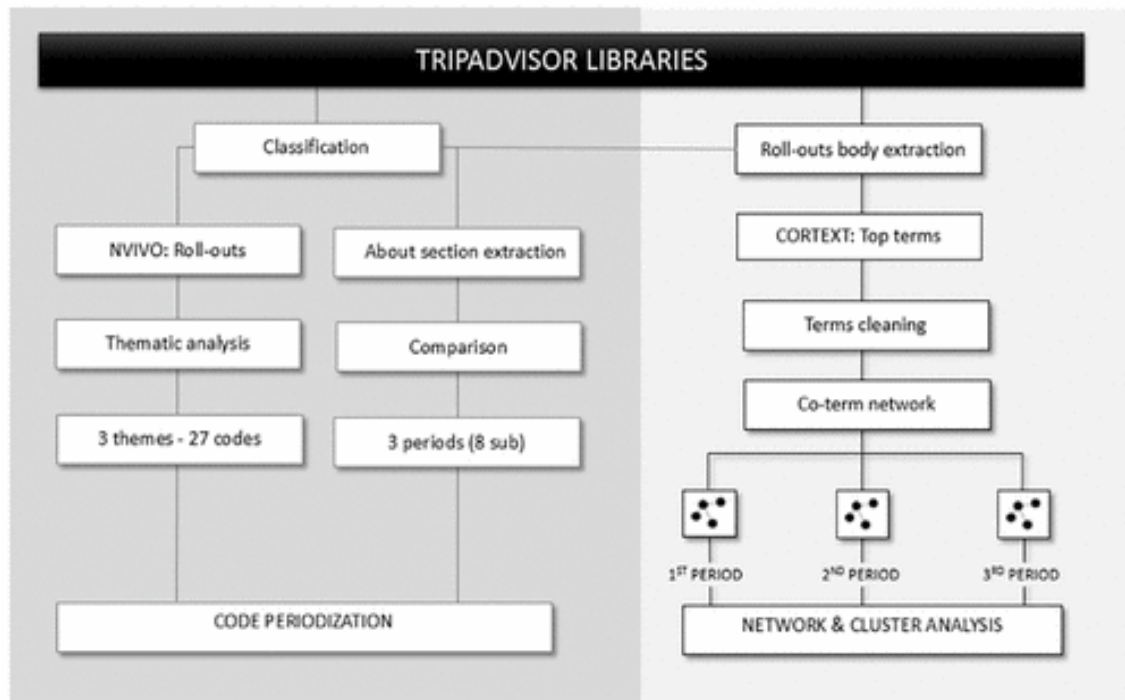
Figure 3. Data analysis methods.

The final step of the process is the generation of the co-term network. To do this, we used CorText to compute the dictionary so as to obtain all the significant co-occurrences of the terms and their connections in the corpus. In our network, the nodes are the terms in our dictionary whose size depends on the number of occurrences in the text corpus. The edges are the links between nodes and represent the co-occurrence of them. The thickness of the edges is given by the number of times that two terms are mentioned together in a text corpus. The network spatialization and its interpretation depend on the selected layout algorithm as these algorithms emphasize different characteristics of the network. We used the Atlas force algorithm that simulates a force system in which the nodes repel each

other and the edges bond the nodes together. Densely connected nodes are located at the periphery of the graph surrounded by the nodes connected to them. The agglomeration and dispersion of nodes facilitate the visualization of topical clusters. We assigned different colours to clusters to further simplify visual inspection. To be clear, clustering is a mathematical operation that imposes a division where it does not exist. This is particularly relevant to have in mind for nodes that are on the boundaries of clusters since in these cases the assignment to a determined cluster is not definitive. We divided the corpus into the three stages of evolution previously identified in the thematic analysis and generated each of their co-terms network graphs. This allowed us to better understand the landscape of topics in each period and to uncover patterns in TripAdvisor's evolution. The co-terms analysis lends further support to the pattern of transformations TripAdvisor has undergone over time (see Figure 2). Figure 3 illustrates the two methods of data analysis.

Results: the pattern of TripAdvisor's evolution

Each of the three stages in TripAdvisor's evolution, we have identified is marked by the development of a certain type of services and the links to various actors in the platform's surroundings. While often sustaining diverse types of resource exchanges, most of the times these links generate specific types of data that variously underpin the operations of TripAdvisor and its services. Figure 4 provides an overview of the key features rolled out in each period and the services and partnerships with which they are associated. From 2000 to 2004, TripAdvisor operated mostly as a search engine. This is evidenced by the growth of search and advertising services that mark the establishment of TripAdvisor as a search travel database and a travel advertising platform. The second stage is closely associated with the development of social (or Web 2.0) mobile features and inter-platform connectivity. Although the first social media features were rolled out in 2004, it is not

until the beginning of 2006 that TripAdvisor starts to portray itself as a user-generated content (UGC) platform. The third and last stage coincided with the introduction and enhancement of booking and end-to-end services that are part and parcel of the broader transformation of TripAdvisor from a social media platform to a hub of a complex ecosystem of other entities and platforms.
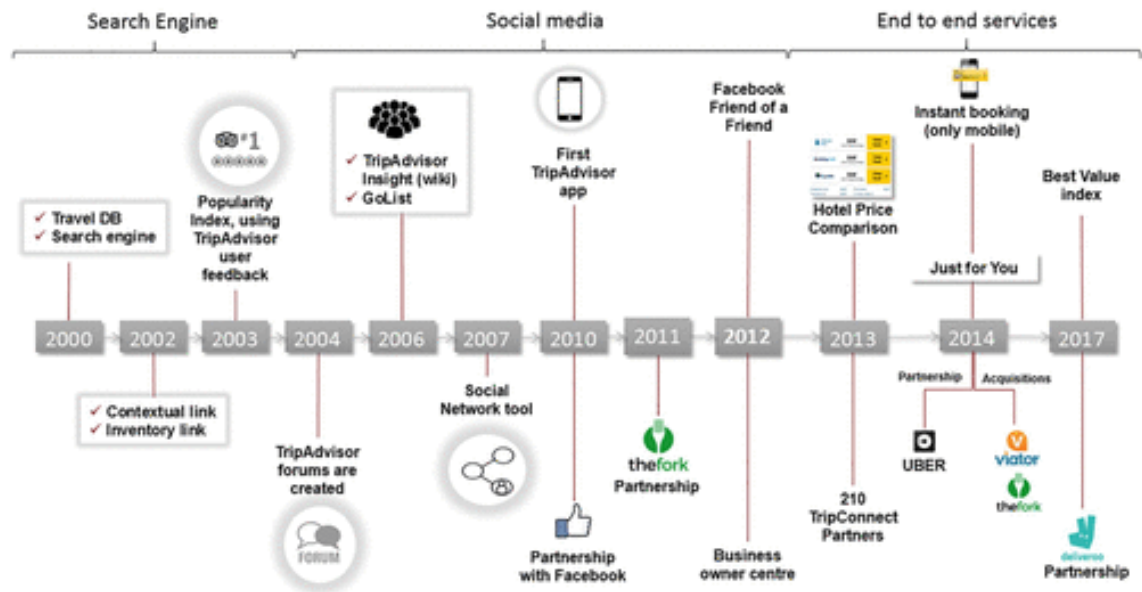
Figure 4. TripAdvisor's evolution.

In what follows, we describe each of the three stages with a focus on the services, data and actors that prevail in each one of them. We conclude the description of each stage with a brief explanation of the main results of the thematic and co-term network analysis (detailed in the figure captions).

Kick-off: search engine and advertising

Back in 2000, the Web was populated with rich travel content sites, yet travel information was fragmented and hard to find. Having seen the opportunity of providing a service, TripAdvisor quickly positioned itself as a search engine and built a database with up-to-date travel content by indexing relevant online travel sites and manually classifying them (Livingston, 2007: 364). As part of improving the retrieval of comprehensive travel information about destinations, TripAdvisor was one of the first sites able to respond to

multidimensional queries and launched a dynamic hotel index that provided an 'up-to-date view of the most popular hotels in a given city' (TripAdvisor, 2002b):

"In contrast to other hotel indexes which statically rank hotels alphabetically or by price, TripAdvisor's new hotel index is the first of its kind to dynamically rank hotels worldwide based on the popularity of a given hotel, as measured by both the quantity and quality of content written about the hotel on the web".

To monetize its search services, TripAdvisor implemented contextual link advertising. This refers to the display of highly targeted ads selected automatically on the basis of user data (i.e. profile, search queries). By 2002, contextual link advertising signified a break away from traditional banner advertising. Unlike traditional banners, a contextual link matches user search data with related ad categories, displaying relevant ads that eventually are clicked through. This change brought about a considerable improvement in the conversion rates of advertising (TripAdvisor, 2001). The offering of contextual links required indexing advertisers' products to TripAdvisor's database (Livingston, 2007; TripAdvisor, 2002a). To do this TripAdvisor built Inventory Link, a lead generation service, which 'automatically indexes an advertiser's entire product database, creates unique HTML commerce links for each product and syncs these links with its search database without involving the advertiser' (TripAdvisor, 2002a).

The main services offered by TripAdvisor in this period were thus search tools for travellers that were monetized through advertising (see Services in Figure 5). The metadata on the basis of which travel content and products were indexed and classified in TripAdvisor's database (see Data Production in Figure 5) facilitated data consultation (e.g. multi-queries) and enabled the implementation of dynamic indexes, further enhancing TripAdvisor search services. Already at this stage, TripAdvisor adopted user

ratings that were, however, indexed from other travel hubs and then manually classified and weighed. During this period, data were mainly procured from travel hubs and advertisers (see Ecosystem in Figure 5).

Figure 5. First-period thematic analysis.

The first period's co-terms network graph (see Figure 6) gives an account of the structural relations between terms making visible three clusters of topics. These clusters represent different and distinct groups of terms that tend to co-occur next to each other. The green cluster accounts for 38% of the archival entries of the first period. The size of the node 'TripAdvisor search tools' shows that this is the term that occurs more frequently in the archival entries of the first period; 'travellers search' is the term that has more connections as it is in the middle of the cluster and features many thicker edges. The terms grouped into the two clusters at the bottom reflect the advertising services that TripAdvisor offered. The terms in the orange cluster suggest a comparison between traditional advertising (banners) with the one that TripAdvisor provided (contextual links), while the highlighted terms on the blue cluster describe how TripAdvisor implemented its advertising service. Interestingly, the 'Travel Site' node is situated in the middle of the network graph and it is the only connection between the top cluster and the bottom one (see the caption of Figure 6 for a detailed reading of the image). The topical clusters obtained by the co-terms graph reinforce the perception of TripAdvisor produced by the thematic analysis and show search and advertising as standing at the centre stage of the platform operations and the services it offered during this period.
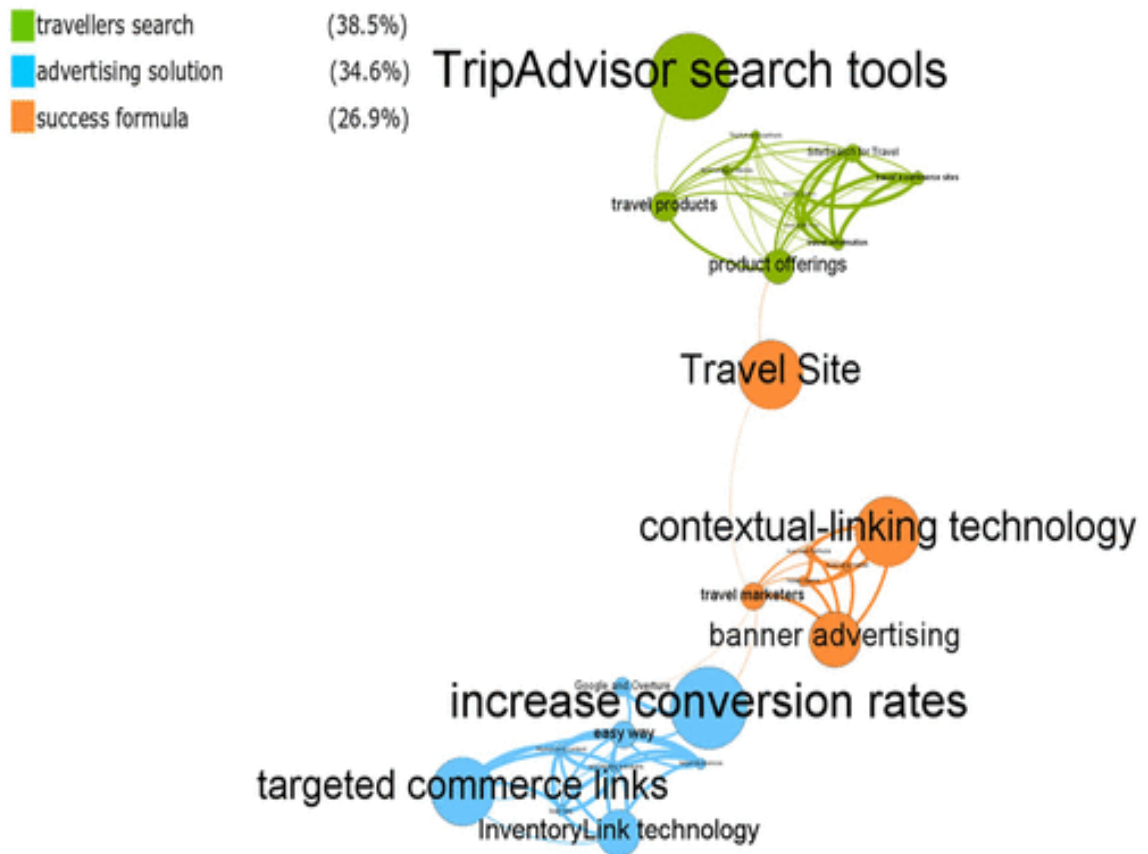
Figure 6. First-period co-term network graph.

From the top: the green cluster accounts for 38% of the archival entries in the first period. The size of the node 'TripAdvisor search tools' shows that it is the term that occurs more frequently. 'Travellers search' is the term that has more connections as it is in the middle of the cluster and features many thicker edges. Other significant terms insofar as co-occurrence is concerned are 'travel preference', 'travel information' and 'SiteSearch for travel'. All these terms stand for and confirm that TripAdvisor at the time was mainly focused on search capabilities. The orange cluster accounts for 27% of the entries in the first period. 'Contextual-linking technology' is the most frequent term in the cluster; 'success formula' and 'business model' are the terms that tend to occur more frequently with other terms of the clusters. Also, 'banner advertising' and 'travel marketers' are part of this cluster. The terms grouped into the two clusters at the bottom reflect the advertising services that TripAdvisor offered in this period. The terms in the orange cluster suggest a comparison between traditional advertising (banners) with the one that TripAdvisor provided (contextual links), while the highlighted terms on the blue cluster describe how TripAdvisor implemented its advertising service. The blue cluster at the bottom accounts for 34% of the entries in the first period. In this cluster, 'increase conversion rates' and 'targeted commerce link' are the terms that occur more frequently and 'advertising solutions' and 'easy way' are the terms that have more co-occurrences with other terms. Other terms that have a higher level of co-occurrences are 'InventoryLink technology', 'target audiences' and 'TripAdvisor content'. Interestingly, 'Travel Site' node is situated in the middle of the network graph and it is the only connection between the top cluster and the bottom one.

Social media platform and inter-platform connectivity

TripAdvisor evolved into social media in a stepwise fashion by attributing growing importance to user participation as a means for generating content and data. The first real social media feature launched was *the Interactive Web Forums* in 2004. The Web forums

enabled users to read comments, post questions and reply directly to other users' posts, generating interactive discussions about a topic. This is why we take this year as the starting point of the second stage of TripAdvisor's evolution. Overall, this stage is marked by the enhancement of social or, as they are often called, Web 2.0 functionalities. The introduction of *Wiki functionalities* or *goList* allowed users to share their collective knowledge about destinations around the world. The move was in line with bigger changes on the role of users in generating and assessing Web content and TripAdvisor used it to gain traction as innovator sustained by users. Unlike most of the travel guidebooks written by a few professionals, TripAdvisor was able to feature real-time travel information posted and voted by users and rich content on a variety of topics. Reflecting these developments, the definition of the hotel popularity index changed at the beginning of 2005. While the previous index measured popularity using Web information, a new algorithm was developed that used 'real reviews by real travellers posted on TripAdvisor.com' (TripAdvisor, 2005). This change signalled a turning point in TripAdvisor's evolution as it made user-generated content and other user data produced on the platform a milestone of its operations.

In the middle of 2007, TripAdvisor launched its first networking feature called *Traveller Network*, which signalled another milestone in TripAdvisor's evolution towards enriched connectivity, community building and increased reliance upon the wisdom of the crowd (TripAdvisor, 2007a). This feature allowed TripAdvisor users to connect directly with other users and share travel information. Through this social networking functionality, TripAdvisor started to gather data on user behaviour on the top of data about destinations. Further improving these services, TripAdvisor launched in 2010 *TripAdvisor Trip Friends* in partnership with Facebook. This ground-breaking feature made it possible for TripAdvisor users to obtain advice from their Facebook friends. Similar to the *Traveller*

Network feature, *Trip Friends* displayed a list of Facebook friends who had already been to the location a user was searching for. To use *Trip Friends*, users were required to log-in via Facebook, making possible the identification of the association 'friends-locations' via the *Cities I've Visited* – a TripAdvisor app on Facebook. *Cities I've Visited* was one of the most popular travel applications on Facebook for nearly three years, with more than 5 million monthly active users and highlighted over 1 billion destinations (TripAdvisor, 2010). Adding an extra tier in the network that TripAdvisor's (2012) users could maintain on Facebook, the *Friend of a Friend* feature was launched in 2012. Sharing friends of friends allowed the expansion of a user's network which in turn soared to tens of thousands of users in the average social graph of users on TripAdvisor (the network of user relations on a social media platform). The expansion of social graph is directly connected to the number of opinions available to each user as TripAdvisor used it to display its reviews results. In a further move toward personalized services, in late 2014, TripAdvisor launched the *Just for You* feature which sorted hotels based on a user's individual preferences and search history on the platform (TripAdvisor, 2014d).

Seeking to expand and capture relevant content and data, TripAdvisor started to connect with other social media platforms through the development of apps (*Cities I've Visited, Traveller IQ Challenge and Local Picks)*. These apps were able to access public profile information available on the host platform, including users' friend lists, interests, photos and albums, video, as well as status and mood (TripAdvisor, 2008). During the same period, TripAdvisor continued strengthening its connectivity with other platforms and expanding its user services. Thanks to the partnership with OpenTable, Toptable and TheFork – leading providers of online restaurant reservations – TripAdvisor's users were able to find and book restaurants. TripAdvisor also offered dynamic maps, using Google

maps to show where restaurants are located and, taking advantage of the mobile geolocation capabilities, helped users find the best restaurants, as rated by locals.

Fostering its relationship with business owners (hotels, restaurants), TripAdvisor launched at the end of 2008 the 'owner centre' that helped businesses manage their online presence and engage with TripAdvisor's community. For instance, registered businesses received notifications of new reviews, had access to management response tools, as well as instructions for updating property listings, uploading videos and photos, and so on. Also, an analytics dashboard was implemented. This made it possible to obtain an instant assessment of customer satisfaction and competitive landscape. At the beginning of 2010, TripAdvisor launched the 'Business Listings' feature, which enabled owners to add or update content to their TripAdvisor profile. For example, owners were able to add a link to their websites or select three reviews to be shown upfront. Also, they could promote 'special offers' to be accessed only by TripAdvisor users. These special offers acted as a differentiator with respect to other businesses by increasing the visibility on the site. The businesses that had special offers were displaying them in upper positions, in addition to the fact that the offer itself was highly promoted on the site. To encourage users to give their feedback about the businesses, TripAdvisor developed *Review Express*. This tool gave business owners the opportunity to gather feedback and reviews through customizable emails which were set up in the owner centre by adding emails to past customers.

The features launched in this period highlight the development and proliferation of two groups of services (see Services, Figure 7). The first group (Wisdom of Crowd – WoC) gathers typical networking services that enable users to access opinions and comments directly from fellow travellers on TripAdvisor and from their online social network and

consult with the popularity index. The second group of services are directed to business owners and mark the beginning of a more active role for them in the generation of the content of their platform profiles. In this stage, we can see the consolidation of UGC production and other social features that started timidly in the previous stage. UGC (reviews and posts), social network (links between users) and social data (e.g. likes and tags) are a fundamental part of the delivery of WoC services (see Data Production, Figure 7). Also, the display of business profiles becomes constantly updatable, reconfigurable and customizable for each user, depending on their past activities on the platform and their online social network. Another fundamental difference with the previous period is the steady growth of connectivity with other platforms, especially with social media platforms (see Ecosystem, Figure 7) that increases the distribution and circulation of data throughout the platform ecosystem.

Figure 7. Second-period thematic analysis.

The co-term network graph for this period (see Figure 8) identifies seven topical clusters. In the upper part of the graph, the dominant cluster is the orange which accounts for 15% of the archival entries of the second period. The most frequent terms and connected terms are 'Business Listings subscribers' and 'Owner Management Center'. The terms in these two clusters refer to the services that TripAdvisor provides to business owners and are only available for businesses which have a subscription through the TripAdvisor business site (the Owner Management Center). In line with the thematic analysis, these two clusters show a proliferation of branding and analytics services available for business owners.

Also, these clusters and the thematic analysis both reveal that business owners started to have an active role in the generation of content in the platform which did not occur in the previous period.
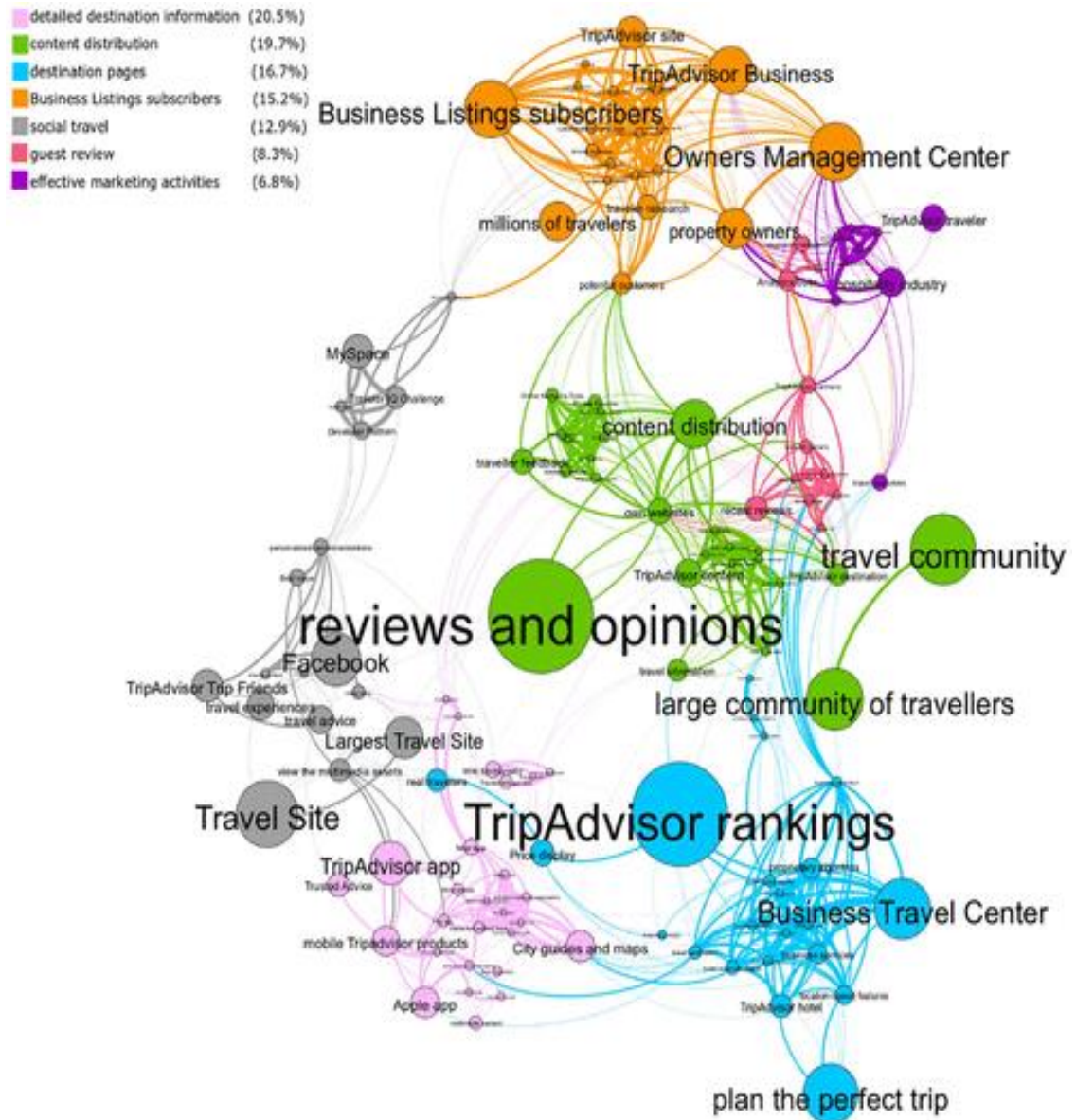
Figure 8. Second-period co-term network graph.

From the top: the orange cluster accounts for 15% of the archival entries. The most frequent terms and connected terms are 'Business Listings subscribers' and 'Owner Management Center'. Other relevant terms in this cluster are 'property owner', 'customizable property page', 'billing options', 'potential customers' and 'TripAdvisor Business'. The purple cluster accounts for 7% of the entries, the term 'effective marketing activities' is the central node due to its co-occurrences; 'hospitality industry' and 'TripAdvisor traveler' stand out for their occurrence as well as 'online reputation', 'resource platform' and 'free tools'. The central part of the graph is dominated by the terms that belong to the green cluster, featuring 'reviews and opinions' as the largest node in the cluster and in the network. This cluster accounts for 20% of the entries and its most connected node is 'content distribution'. Other relevant terms in this cluster are 'traveller feedback', 'TripAdvisor destination', 'TripAdvisor content', 'travel information', 'own websites', 'rating and photos', 'travel community' and 'large community of travellers'. The rose cluster

which stands very close to the green cluster features 'guest review' as the most connected node and its most frequent terms are 'Analytics Suite' and 'recent reviews'. Other terms that stand out in this cluster are 'trust consumers', 'tools for owners', 'TripAdvisor partners' and 'e-commerce companies'. The grey cluster is located slightly out of the central point of the graph and accounts for 12.9% of the entries. The most connected node is 'social travel' and the most frequent terms are 'Travel Site', 'Facebook', 'TripAdvisor Trip Friends', 'MySpace' and 'Largest Travel Site'. This cluster makes visible the rise of networking tools and the interconnectivity with other social media platforms. The pink cluster represents 20% of the entries and features terms related to services offered through mobile devices. However, it also has terms such as 'Wiki functionality', 'TripAdvisor goLists' and 'Insider tips', which are close to the grey cluster and also related to networking tools. The blue cluster accounts for 17% of the entries but its terms do not clearly relate to a unique topic. The most connected node is 'destination pages' and the most frequent in the entries is 'TripAdvisor rankings'. One group of this cluster is related to the rankings and indexes that TripAdvisor generates with proprietary algorithms (i.e. 'proprietary algorithm', 'hotel search engine' and 'quantity and quality'). Another group can be associated to TripAdvisor content (i.e. 'plan the perfect trip', 'access travel information', 'real travellers', 'and travel destination', 'hotel overview pages'). The terms 'TripAdvisor forum' and 'location-based feature' can easily be linked to neighbouring clusters.

The central and lower part of the graph gathers the most frequent terms that are related to user involvement and the services TripAdvisor offers to users. The central part of the graph is dominated by the terms that belong to the green cluster and features 'reviews and opinions' as the largest node in the cluster and in the network. This cluster accounts for 20% of the entries and its most connected node is 'content distribution'. It shows that user-generated content obtains a diffused platform presence throughout this stage, corroborating the results of our thematic analysis. One of the key characteristics of this period is the central role of the user-generated content in the operations of TripAdvisor's and, ultimately, its services. The rose cluster which stands very close to the green cluster is a good example of it. The most connected node is 'guest review' and the more frequent terms are 'Analytics Suite' and 'recent reviews'. The nodes 'Analytics Suite', 'customer satisfaction' and 'review page' are located closer to the cluster at the top rather than to the other nodes of their cluster because they are tools available through the owner management centre. This cluster highlights TripAdvisor tools that owners can use to encourage their guests to write reviews and to see their business performance based on ratings and reviews. The grey cluster is located slightly out of the central point of the graph and it accounts for 12.9% of the entries. The most connected node is 'social travel'. This cluster reveals the rise of networking tools and the interconnectivity with other social

media platforms. Similar to the thematic analysis, the co-term analysis shows that networking tools are a key characteristic of this period. The caption of Figure 8 offers a more detailed reading of the network graph.

End-to-end service ecosystem

This stage is marked by the proliferation of partnerships that enable TripAdvisor to offer end-to-end services, whereby users are allowed to experience the entire travel consumption process ending up with a booking. Similar to the previous passage from search engine to the social media platform, the transition to end-to-end services has grown stepwise, building on the previous stage, as the partnerships with OpenTable, Toptable and TheFork indicate.

Hotel Price Comparison, launched in June 2013, marked a watershed in the offering of end-to-end services from the display of prices to booking (TripAdvisor, 2013a). TripAdvisor was the first to match real-time pricing and availability with TripAdvisor's reviews and opinions in a simple layout. Price and availability are obtained from multiple booking partners (OTAs and IBEs) and displayed in one view. When users pick the dates of stay, TripAdvisor displays a list of available hotels with their prices. By these means, users can search and compare hotel prices at a glance, without having to leave the platform. Users can easily select and book their hotel by clicking through to the booking partners' sites to complete the transaction. With the implementation of this service, accommodation owners could partake in services previously limited to major OTAs and large hotel chains (TripAdvisor, 2013b, 2013c). Hoteliers take part in the bidding process that sorts the display of booking options to the users, which is important to drive direct bookings to their own site. In addition, TripAdvisor rolled out *Instant Booking* which made it possible for users to complete the whole booking process onsite. This feature was

first available for mobile devices in June 2014 and extended to all devices in the United States and the United Kingdom by September 2015 with a global rollout in 2016 (TripAdvisor, 2014a, 2015).

The interface simplicity and immediacy of *Hotel Price Comparison* and *Instant Booking* conceal a thick layer of interweaving messages and data flows among TripAdvisor, OTAs, hotels and IBEs (see Figure 9). IBEs, for instance, are not visible on TripAdvisor's site, yet they play a key role as they provide hotel room availability information in real-time. Importantly, the circulation of this information (and thus of booking service) occurs only for hotels which have IBEs with TripAdvisor connectivity-partner certificate and have a premium subscription. Also, OTAs and hotel chains need to be a TripAdvisor connectivity partner. To obtain the connectivity-partner certificate, partners are required to implement TripAdvisor APIs and complete two integration testing processes.
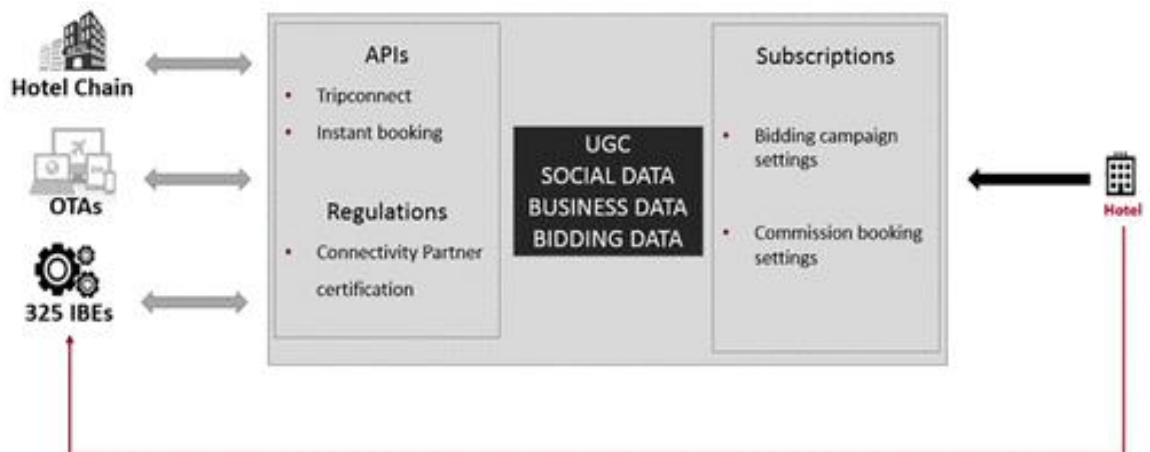
Figure 9. TripAdvisor data flow ecosystem.

Leveraging on the acquisition of TheFork in 2014, TripAdvisor launched *Instant Reservation* (TripAdvisor, 2014c). This feature allows users to complete their restaurant's table reservations without leaving the site. On November, also the *Attraction* section exhibited an Instant feature by integrating tour inventory display and pricing data from Viator, which had been acquired by TripAdvisor in August 2014. When users visit an

Attraction page on the site, they are presented with up to three tour options, such as small group, private or skip-the-line options, along with descriptions and prices for each. An instant booking functionality complements the offering.

As part of the inter-platform connectivity expansion, in 2014 TripAdvisor announced a new feature for mobile called *Ride there with Uber* (TripAdvisor, 2014b). This allowed users to easily reserve a ride with Uber to restaurants, attractions and hotels. TripAdvisor was one of the first to integrate Uber functionality into its platform using Uber APIs. When users search for restaurants, attractions and hotels on TripAdvisor they are presented with an estimate of Uber car fares and the waiting times for pickup. Clicking the *Ride there with Uber* button allows redirecting to Uber, thus completing the reservation and having a car sent to the user location. In a similar move, TripAdvisor teamed up with Deliveroo enabling its users to access to Deliveroo's restaurant network. The scheme connected more than 20,000 restaurants across 12 countries throughout Europe, the Middle-East and the Asia Pacific regions. Restaurants listed in both TripAdvisor and Deliveroo have displayed a button order online. By clicking it, TripAdvisor visitors are redirected to the specific restaurant on the Deliveroo app to complete their orders.

The launch of end-to-end services clearly dominates the third stage of TripAdvisor's evolution. The thematic analysis highlights that users receive or are able to visualize prices and options of reservations while business owners can now actively participate to these services through two price schemes, cost per click (CPC) or commission (see Services in Figure 10). To be clear, once a search is performed on TripAdvisor hotel results are displayed using proprietary algorithms (for instance, 'Best Value'). Each hotel displayed has a list of booking options and corresponding prices. Hotel chains, OTAs and

hotels subscribe to or bid to get the higher position in this booking option list. Commission and CPC are two price schemes which belong to two different modalities of participating in the display of booking options on TripAdvisor. Hotel chains or OTAs subscribing a commission model agree to pay 15% or 12% of commission on their room price to have their booking option displayed at least 50% of the time in the top position. In this case, the booking process occurs on the TripAdvisor's site. The remaining 50% of times the order by which a booking option is displayed is regulated by auction. In this model, the hotel or OTA winning the auction process takes the top position and pays the agreed CPC to TripAdvisor independently from the completion of the booking. If a booking is finalized, it happens on TripAdvisor's partner site (OTAs or hotel chains).
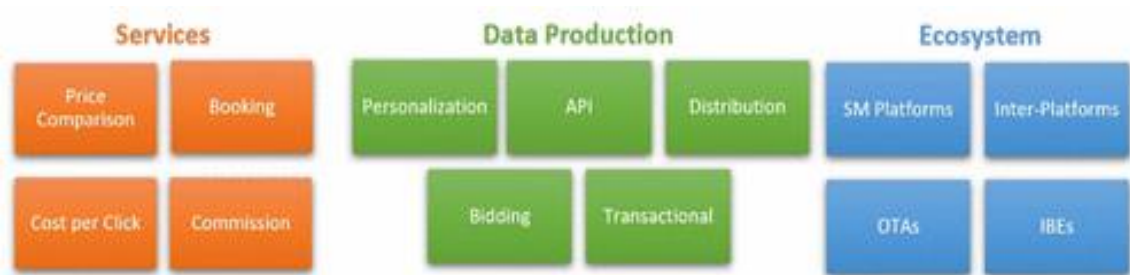
Figure 10. Third-period thematic analysis.

To be able to provide these services, TripAdvisor significantly extended its links with OTAs and IBEs. These links, in turn, play a crucial role in the circulation of data and messages related to booking services, leading to the emergence of a complex booking network (see Ecosystem in Figure 10). A fundamental difference from the previous stage concerns the production of different data and the delivery of data services that did not exist before, such as the personalized destination profiles that are based on user participation data (e.g. just for you) and the production of transactional data (e.g. hotel prices or booking) that circulate along the TripAdvisor ecosystem (see Data Production in Figure 10). Data are primarily distributed by TripAdvisor APIs that govern the circulation of data in the ecosystem.

The co-terms network graph shows eight clusters that are agglomerated mainly at the upper and lower parts of the graph (see Figure 11). In contrast to the previous period, the most frequent terms tend to be at the top of the network and are related to the booking services and other features available for business owners. These terms appear in 56% of the entries. The orange cluster is related to booking services and, significantly, the most connected node is 'TripAdvisor Instant', the name of the API (Application Programming Interface) that rules the direct booking (11% of entries). Similar to the thematic analysis, the co-term graph shows the importance acquired by the development of booking services and the increasing involvement of business owners in the platform. The structure at the lower part of the graph is very similar to the one in the previous period. The purple cluster features terms related to the services available through mobile devices. The most connected among these terms is 'mobile feature' and the most frequent is 'TripAdvisor app'. Interestingly, 'reviews and opinions' is located in the middle between the purple and the rose clusters, which is more related to the website. This may reflect the increase in traffic through mobile devices. The terms in the pink cluster refer to filters, indexes and rankings that TripAdvisor uses to display data, while the rose cluster represents the content TripAdvisor offers to users.
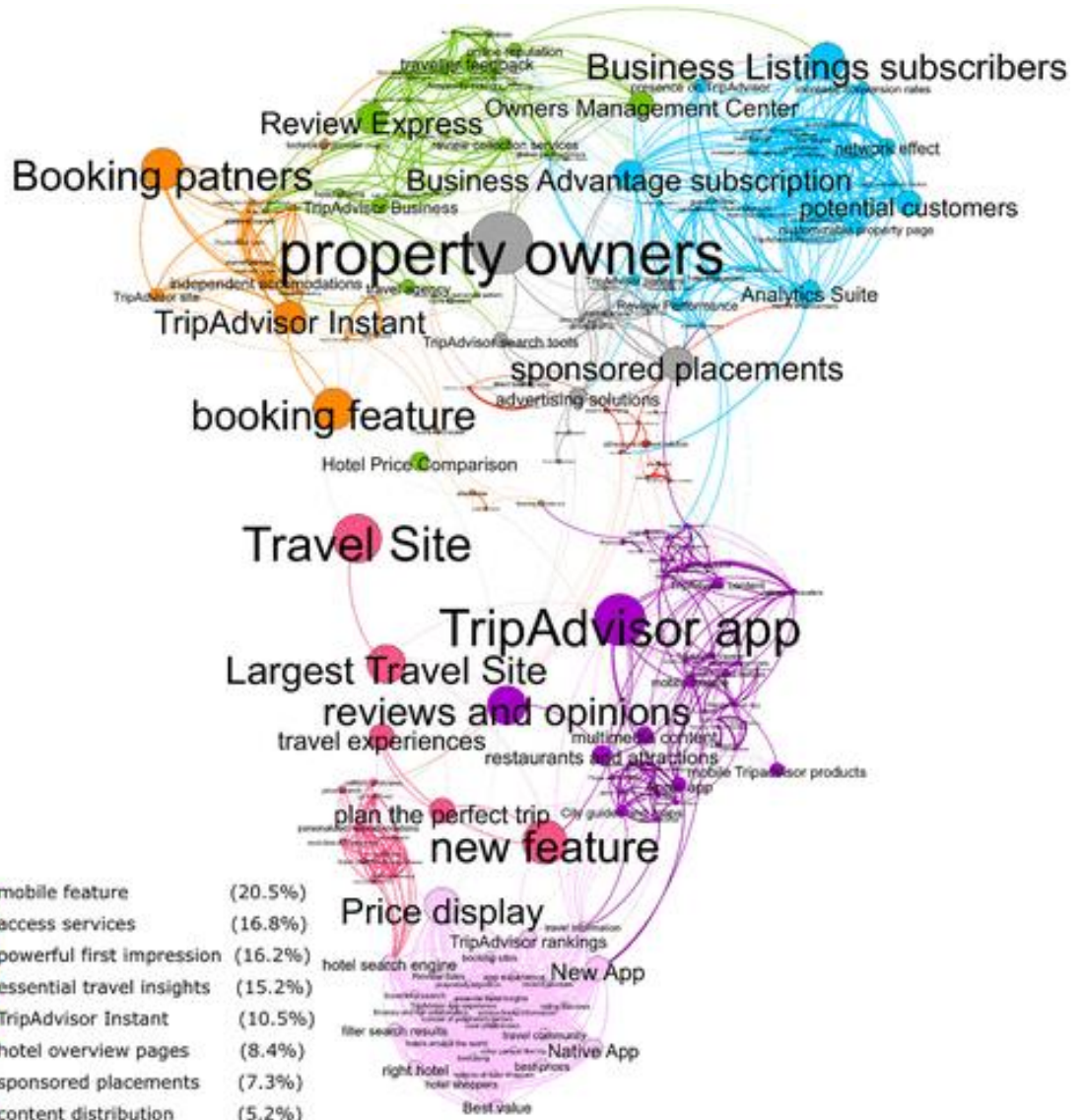
Figure 11. Third-period co-term network graph.

From the top: the orange cluster is related to booking services. 'TripAdvisor Instant' is the most connected node and the name of the API that rules the direct booking (11% of entries). Other relevant terms in this cluster are 'Connectivity partners', 'booking features' and 'independent accommodation'. The terms in the green cluster are mostly related to features available for business owners through the 'Owners Management Center'. 'Review Express', 'Customizable emails', 'latest trend', 'review collection services', 'customizable property page', 'Online Marketing tools' and 'online reputation' are all functionalities to facilitate the branding. Also, this cluster features terms such as 'travel agency', 'Hotel Price Comparison' and 'own websites' that are related to CPC booking services. Business owners with a subscription can set their bets through the 'Owners Management Center'. In the blue cluster, the terms 'Business Listings subscribers' and 'Business Advantage subscription' excel for their size. The business listings subscription provides access to the booking services and a basic number of branding and analytics tools, while the business advantage subscription has full access. Meaningful terms in this cluster are 'customer satisfaction', 'Analytics Suite', 'data insights', 'increase conversion rates', 'Review Performance' and 'competitors sets'. These terms represent the tools that TripAdvisor offers to visualize business performance. Also, in this cluster are terms more related to branding services like 'customizable property page', 'network effect' and 'drive engagement'. The grey cluster also refers to advertising options available for premium subscription. Its most connected node is 'sponsored placements' and other relevant nodes are 'advertising solutions' and 'drive traffic'. This service places property link in a prominent location when a potential customer is looking in the property area.

Discussion

In what follows, we interpret and theorize the events we have outlined in our empirical narrative. We first link the evolution of TripAdvisor to the practices by which the company has sustained its steady innovation and expansion over time. A great deal of these practices pivot around the original production and use of various types of data. We subsequently explore how these data practices are associated with the formation of the ecosystem in which TripAdvisor is currently embedded and the links that tie ecosystem participants together.

Data, technologies and actor configurations

While sharing some essential attributes with one another, each of the three stages in TripAdvisor's evolution features distinct set-ups of organizational operations and capabilities. Each stage, furthermore, develops within particular business environments made of diverse configurations of actor positions, roles and interdependencies (see Table 4). All of these can and, in fact, have often been studied with a focus on the managerial and economic rationalities that drive the development of market strategies and organizational capabilities, and the formation of business networks or alliances (see, for example, Adner, 2017; Gawer, 2014; Jacobides et al., 2018; Parker et al., 2016; Teece, 2018). While insightful, research of this type tends to gloss over the link between economic rationality and the technological conditions that make some courses of action possible while rendering others less successful or even obsolete (see, for example, Teece, 2018). Placed upon a larger time window, technological conditions establish the framework within which particular actions and choices develop and, in this regard, need careful consideration and analysis.

Linking technology to economic action is, no doubt, a non-trivial challenge that requires approaching technology as a structuring force that shapes economic and social relations (Borgmann, 1999; Faulkner & Runde, 2013; Kallinikos et al., 2013) and frames what actors can and cannot do (Orlikowski, 1996; Zuboff, 1988), a task that may be considered insidious and unattractive. Be that as it may, relegating technology to a background condition would seem out of tune with the current world in which economic relationships are increasingly expressed, instrumented, conducted and monitored by means of various blends of specific and generic technologies (Arthur, 2017; Teece, 2018). In the context of platform ecosystems, in particular, the transformations we describe in this article are supported by ongoing technological developments with respect to the functioning of the Internet, the diffusion of standards, devices and technologies that intermingle with the daily pursuits of people and bring about new patterns of exchange, interaction and communication (Alaimo & Kallinikos, 2017, 2019a; Hanseth & Lyytinen, 2010). Aligned with the theoretical concerns sketched at the frontend of this article, we link the evolution of TripAdvisor to the inventive establishment of data practices by means of which the platform has sought to tune with and take advantage of the pervasive nature of data and the critical importance data management operations have acquired in the making of the current digital economy (Alaimo & Kallinikos, 2017; Barrett, Davidson, Prabhu, & Vargo, 2015; Henfridsson et al., 2014; Yoo, 2013).

Table 4. The evolution of TripAdvisor.

	Search engine	Social media	End-to-end services
Data types and formats	Hotel data Destination data (both imported from hotel websites and the Web) Product data (HTML links)	Social data (actions and opinions by user platform participation Network data (friends' and friends of friends' data from social media platforms) User-generated content (reviews, forum, Q&A)	Transaction data (booking generated by users and bidding generated by hotels and OTAs)
Technological functionalities	Indexing and classifying Searching (multi-query)	Networking Producing and consuming content (wikis, rating, reviewing) Personalizing results (filtering, selecting) Subscribing	Comparing (price and content) Booking Bidding
Configurations of types of actors, roles and positions	Advertisers (OTAs and big hotel chains and travel sites at the beginning)	Social media platforms App development and decentralization Advertisers	OTAs IBEs Sharing economy platforms Apps acquisition, integration of services and decentralization

Table 4 offers an analytic summary of our findings and the practices that underpin the transformation of TripAdvisor from a travel search engine to a salient travel social media platform and subsequently to a central hub of a travel service ecosystem. To begin with, each of the three stages is linked to different *types of data* that constitute the pervasive 'material' underpinning most operations and key services of the platform. The first transition from the original travel search engine stage to social media travel platform and network stage essentially coincides with the shift from the use of traditional and already available travel data sources (hotel, destination and product data) to a new and until then largely unknown data type, produced by large user crowds contributing their reviews, ratings and networking data to the platform amass. This transition remains pivotal to the market position and the public image of TripAdvisor alike and forms one of the foundations on which more recent transformations are based.

The second transition to the end-to-end service ecosystem is marked by the growing use of several types of transaction data. While such data serve operations such as bidding and booking, they are also used in conjunction with other data types to develop data-based services that feature the cross-syndication of data to large data pools (aggregation) out of which a variety of metrics and scores are computed(Alaimo & Kallinikos, 2017; Kallinikos & Alaimo, 2019). Take the example of the display of hotel results which now works on the basis of (1) traveller ranked, (2) best value, (3) lowest price and (4) distance. The first measure is still obtained by crunching traveller data. Yet the second of them (e.g. best value) is far more complex and entails miscellaneous types of dynamic data from several sources. Best value is computed using 'TripAdvisor data, including traveller ratings, confirmed availability from its partners, prices, booking popularity, location and personal user preferences' (www.tripadvisor.com). Hotels are ranked on the basis of their real-time room availability which is, in turn, conditioned by the deals that hotels have

with partners and with TripAdvisor. Furthermore, TripAdvisor is now able to compute data on booking popularity across all the partners (325 IBEs, OTAs, hotels and hotel chains) and to refine its knowledge on user personal preferences across a number of services and platforms.

All these operations are linked to and variously supported by different *technological functionalities* (Table 4). The transition from travel search engine to social media travel network corresponds to an underlying technological switch from indexing-classifying-searching to the use of social or interactive (Web 2.0) technologies characteristic of the second stage. In a roughly similar fashion, the transition to the third stage coincides with the development and implementation of a technological infrastructure that supports dynamic price comparison, bidding and booking, allowing TripAdvisor to become a major hub in the travel service ecosystem to which it belongs. Studying the transformation of TripAdvisor over time without regard for the data practices and technologies that underpin the creation of new services made of data amounts to glossing over the nature of the developments we have reported in this article and, particularly, how they have been materialized (Kallinikos, Leonardi, & Nardi, 2012).

Finally, the types of data and the technological functionalities that underpin the evolution of TripAdvisor are linked to varying *configurations of actors, roles* and their *positions* (Aaltonen & Tempini, 2014; Constantiou et al., 2017; Henfridsson & Lindgren, 2005), in each of the wider settings that roughly correspond to each stage. The first stage is marked by the ubiquity of contextual advertisement and the consequent importance of advertisers (OTAs or advertisement agencies) and Internet users as travel information seekers. The second stage features the importance of users not simply as information seekers but crucially as producers of data (reviews and ratings, networking data) on the basis of which

TripAdvisor develops key services such as hotel and place popularity indexes and personalizes offerings to travellers. Actors at a remove from the boundaries of the hospitality industry, such as app developers and other social media platforms (notably Facebook), rise to important partners at this stage. Many of these actors continue to hold strong positions in the current ecosystem, yet their relative importance is redefined by the introduction of new actors such as IBEs, Uber or the Fork and the ubiquity of operations such as bidding, booking and price comparison. Positions and roles are increasingly dependent on the acquisition of technological and data production capabilities. IBEs, for instance, have risen to be an important player within the ecosystem because they are able to command the real-time flow of data on room booking and availability from small and medium hotels to TripAdvisor.

It remains a key question whether the last stage of TripAdvisor's transformation we identify with the end-to-end service ecosystem is indicative of its transition away from the importance end-users have historically obtained in defining the public image of TripAdvisor as a social travel platform and network and, certainly, its economic success. It would be hard to imagine that TripAdvisor can afford to dispense with the contribution users as data producers make to is economic well-being. User-generated content, social and networking data still continue to play an important role in the services TripAdvisor offers (personalized services, popularity indexes) while user reviews and ratings contribute to the public attraction of the platform. On the other hand, it is reasonable to assume that the propagation of services that rely on transaction data (e.g. bidding, booking) and are linked to the formation of the end-to-end-service ecosystem in which TripAdvisor is a central hub by implication reframe the relative importance of user-generated reviews and ratings, social and networking data and, more generally, the role end-users have so far had in the platform. A better understanding of these issues requires

dealing with the question of how different types of data lead to the formation of service ecosystems.

Data and ecosystem formation

Current research on platforms and platform ecosystems conceives of the links of ecosystem participants in terms of the operational and economic advantages they confer to them. Ecosystem formation occurs as a result of specific and value-reinforcing complementarities that extend beyond bilateral relations, entailing multilateral connections, often across industry boundaries (e.g. Adner, 2017; Jacobides et al., 2018; Teece, 2018). The multilateral relationships of TripAdvisor with IBEs, OTAs, hotel chains and independent hoteliers and restaurant owners, end-users and other social media organizations provide a good illustration of how the interdependent nature of such links leads to ecosystem formation and to resources and services that acquire higher value to the degree that they become bundled with one another. Yet, what is thus bundled is made of data. In contexts such as the ones we report here, most of the links between firms, resources or activities are expressed and instrumented as data relations and it is primarily in this form that they become the objects of ecosystem practices and exchanges. To express it bluntly: no data, no services.

Cast in this light, data emerge as a key *carrier of value* but also as the *cognitive medium* on the basis of which links between ecosystem participants are forged. Certainly, data and the actor links they underpin are dictated by economic considerations. They variously reflect the business objectives of the ecosystem participants on the basis of which they are set up and ultimately assessed, and further developed or revised. Yet, the economic analysis of ecosystems that is mostly framed as an argument about ends (interests and objectives) does not have at its disposal the conceptual means for capturing and analysing

the ways services that are essentially data relations are made. It can only analyse the architecture of intentions as these latter are supposedly driven by economic considerations (e.g. competition, market share, price, resource interdependencies) and the strategies they support but fail to deal with the means by which intentions materialize into actual relations. We complement and extend this view by putting forward an argument about means (Orlikowski, 1996) or, perhaps more correctly, about the *structure of means* whose complexity, mutual accommodation and path dependence defy easy subordination to pre-established ends and the pursuits of particular actors (Arthur, 2010; Hanseth, 2000; March, 1994; Yoo, 2013). The different types of data necessary to support the operations of the ecosystem and the practices, technologies and systems by which they are managed constitute a complex grid of sedimented solutions established over time that define actions more than deliberate plans. They considerably shape the type and structure of the links of ecosystem participants and circumscribe the possibilities whereby certain things are possible to pursue while others are ruled out (Aaltonen & Tempini, 2014; Hanseth & Ciborra, 2007). The story of TripAdvisor provides ample evidence to these claims.

These observations acquire a poignant importance in the context of the digital economy in which data have become such a pervasive means for capturing, representing, conveying and assessing social and economic relations. It is crucial thus to uphold that data are not simply a very specific type of resource but also an essential medium, instrument or channel for perceiving and acting upon reality. If, say, the hotel popularity index is rendered complementary to hotel room availability, price comparison and, eventually, booking, this is because they are all brought to bear upon one another as comparable and relatable semiotic (data) tokens. The relatability and comparability of data require a series of operations by which original data are standardized or properly formatted so as to enter into various kinds of relations and comparisons with other data (Kallinikos, 2007; Marton,

Avital, Blegind Jensen, Jensen, & Open Big, 2013). As notational or semiotic systems, all data are in principle, if not in practice, relatable. Cast in suitable data formats, the distinctive and often incommensurable status of the different regions of reality from which they derive (e.g. social and networking data, price comparisons, local conditions) is dissolved into the medium of data relations (Kallinikos, 1999; Monteiro & Parmiggiani, 2019). In other words, data are commensurate (Espeland & Sauder, 2007).

These considerations crystallize into two important implications that contribute to the literature on social media and platform ecosystems. First, the complementarities achieved via the medium of data are not intrinsic or otherwise conditioned by the functional or physical make-up of the resources, activities or outputs which they translate or encode (Arthur, 2017; Kallinikos, 2007). Data complementarities are based on different types of data standardized enough to bear upon one another in ways that reinforce their mutual relevance and, ultimately, value. Of course, relating, say, hotel reviews to hotel prices and, eventually, booking presupposes a cultural background of practices and understandings whereby such actions are rendered meaningful (boyd, 2015; Searle, 1996). Yet, the processes through which different types of data are made to matter, related and combined are anything but trivial. They require establishing the practices that generate data of a certain kind and format (e.g. reviews and ratings) and assembling together different data in more complex services (e.g. popularity index, best value), developing the functionalities that support these practices (e.g. indexing, reviewing, bidding) and the technologies and systems (not simply algorithms) through which these data are handled, exchanged and, more generally, made commercially relevant. In the digital economy in which digital tokens figure prominently, the complementarity of resources is not exactly out there but often fashioned by the semiotic means by which it is expressed (digital data) and the formats that allow such different semiotic tokens such

as numbers, text or images to be inter-operated (Monteiro & Parmiggiani, 2019; W. J. Orlikowski, 1996; Varian, 2010b).

Second, data-based ecosystem formation is more dependent on the practices of data complementarities rather than on pre-existing physically embedded complementarities of traditional products and services (Teece, 2018; Yoo et al., 2010). Data complementarities are reconfigurable and updatable in ways that hardwired resource or output complementarities can seldom be. For this reason, industry and activity boundaries can be crossed in many and unexpected ways (Henfridsson & Lindgren, 2005; Santos & Eisenhardt, 2005; Yoo et al., 2010) that transcend the intrinsic limitations of physical resources to which industry formation has been bound (Kallinikos, 2007). The case of TripAdvisor is revealing in this regard. The platform is now at the centre of a digital travel ecosystem that encompasses traditional services related to the hospitality industry together with new or previously unrelated services that are steadily remade, extended and upgraded. In a constantly expanding list, TripAdvisor now offers digital services related to hotel and restaurant bookings, food-delivery, private car rental, local excursions and various specialist content production and distribution services for a range of heterogeneous actors. Our longitudinal study of these data relations unveils the dynamic process of service ecosystem formation and the constant redrawing of organizational and industry boundaries (Santos & Eisenhardt, 2005) as contingent upon the fashioning of data complementarities.

Concluding remarks

The evolution of TripAdvisor and its economic success are closely related with the practices of data generation and the use of these data to support and materialize a great deal of services that require organizational and industry boundary crossing. Our

longitudinal case study makes visible the set of reciprocal relations that exist between specific types of data and services, technological operations and actor roles and positions. Tracing the trajectories of these elements, our study reconstitutes the developments that have led to the formation of TripAdvisor's service ecosystem against a broader background of technological and cultural conditions (e.g. boyd, 2015; Srnicek, 2017).

We contribute to the literature on platforms and ecosystems by advancing the concept of data-based services which we define as complex and dynamic assemblages of different types of data that describe, stage and moderate the relationships of ecosystem participants (Alaimo & Kallinikos, 2017, 2019b). The capability of a platform to assemble this kind of data-based services is an important precondition for the development of data complementarities and the formation of business relationships that lead to ecosystem formation. The data complementarities that underpin ecosystem formation emerge out of the complex interactions between the prevailing practices of data generation and exploitation and the development of deliberate strategies and platform functionalities. Such interactions ride on, yet further develop the infrastructure and the wider technological and cultural conditions in which a particular ecosystem is embedded.

Placed against this background, our study makes an important qualification of existing theories of ecosystems by disclosing the role of data complementarities and the technological conditions on the basis of which such complementarities emerge or are fashioned in this hyper-technological age. If we are right, data-based service ecosystems and the practices of data complementarities they rely upon are likely to lead to cross-industry ecosystem emergence and innovation on a larger scale (Kallinikos et al., 2013; Yoo et al., 2010). In this sense, our study also contributes to the understanding of developments that transcend TripAdvisor and connect both to the present changes and the

prospects facing social media. The ongoing transformation of other social media companies such as LinkedIn, Facebook or WeChat indicates that our findings have a wider relevance, far beyond TripAdvisor. These ideas, no doubt, need to be further developed and tried empirically in other settings. Future research needs to investigate more closely whether and how various types of data and data links are conducive to the kind of value-reinforcing relations that we associate with ecosystem formation and industry boundary crossing. By the same token, we need to better understand how social media cross the boundary between, on the one hand, community and sociality making and, on the other hand, economic action.

Chapter 3
Patterns of Digital Transformation– A longitudinal Study of TripAdvisor

Abstract

Digital platforms have been mainly studied as business organizations or architectural configurations of technological components, arranged in core-peripheral relations. Both approaches contribute to our understanding of platforms but tend to gloss over the detailed processes that shape platform operations and the ways these operations evolve over time. In this paper, we combine computational methods and qualitative analysis to retrieve and analyse the structure and layout of snapshots of TripAdvisor's webpages with the purpose of accessing these lower-level, micro-foundations of the platform. Our findings indicate four different configurations of technologies, technological objects, data types and data practices that correspond to distinct stages in the platform's evolution from its establishment onwards. The careful unpacking of these configurations further suggests that the platform has moved away from a relatively stable display of web travel information characteristic of its early years towards a progressively dynamic and diversified service ecosystem, whereby most services it offers are made out of the computation of constantly updatable and variable data sources.

Keywords: *Platforms, Evolution, Technologies, Data, Data Practices.*

Introduction

Over the few decades since their emergence, digital platforms have been growing and diversifying their operations. Today, they are an integral part of the organizational arrangements through which resources are produced, shared or distributed and services consumed in most economies around the world (Constantiou et al., 2017; Mcintyre et al.,

2020; Parker et al., 2016). Yet, there is little we know as regards the patterns of platform evolution and the ways platforms respond to and co-evolve with the technological changes that characterize their wider environments (Henfridsson et al., 2018; Tiwana et al., 2010). The study of platforms from the perspective of multisided markets that underlies most economic approaches has undeniably contributed to our understanding of platforms and their ecosystems as complex and often dynamic arrangements of multiple stakeholders but has seldom investigated the fundamental transformations many of them have undergone over their life course (Jacobides et al., 2018; Mcintyre et al., 2020). Focusing mostly on patterns of platform scale and growth, most of these studies often gloss over the underlying technological, institutional and organizational forces that govern these transformations.

Even less is known with respect to how technologies are involved in weaving the detailed fabric of operations and the organizational practices that sustain platforms as independent organizations (Alaimo, Kallinikos, & Valderrama, 2020 [Paper One]; de Reuver et al., 2018). Such a claim may come as a surprise, granted the central role accorded to technology by well-acknowledged studies of platforms (Baldwin & Woodard, 2008; Henfridsson et al., 2018; Yoo, 2013; Yoo et al., 2010). Yet, at a closer look, most of these studies conceive of platforms as predominantly technological architectures built around a stable core and a variable assortment of peripheral elements that provide the foundations by which they respond and adapt to the varied contingencies that confront them. While important and historically much wanted, this architectural understanding of platforms is too macroscopic to allow for the investigation of the detailed fabric of technologically mediated operations that constitute platforms as business organizations.

In this paper, we seek to redress some of these imbalances through the study of the evolution of TripAdvisor. More particularly, we focus on the transformations which the platform has undergone over time. We link the study of these transformations to the underlying technologies and technological objects by which the platform has sustained its operations over the two decades of its existence. We 'read' these transformations by the empirical investigation and analysis of the changes in the structure and layout of the snapshots of the platform's webpages, from its very establishment up to our days. Our findings indicate four different configurations of technologies, technological objects, data types and data practices that correspond to distinct stages in the platform's evolution. The careful unpacking of these configurations suggests that the platform has moved away from a relatively stable display of web travel information characteristic of its early years to a progressively dynamic service ecosystem, whereby most services it produces are made out of evolving, constantly updatable and increasingly diversified data sources. Operating in ways that approximate real-time interaction with users and other actors in the platforms' environment is a hugely complex and delicate task. It requires setting in place the technological and organizational capabilities for dealing with the overflow of data that mark the Internet-mediated ecosystems in which most platforms are embedded and use these data to support commercial operations.

The paper is structured as follows. In the next section, we briefly review the literature on the subject and provide the conceptual underpinnings of our paper that ascribe technology and technological objects an important role in the making of platforms. We subsequently present the methodology we have used and reported in some detail the results of our study. We end up by placing our empirical findings in a broader context of relevance and outlining our contribution to the current literature on platforms and platform evolution.

Conceptual Underpinnings

Research on platforms is diverse and multidisciplinary. A good portion of this research is nonetheless conducted within the field of managerial economics and is accordingly linked to concepts and research techniques of industry analysis and business strategy (e.g. Gawer, 2014; Parker et al., 2016). Viewed as predominantly economic entities, the operations and evolution of platforms are assumed to be driven by the prevailing patterns of competition, network effects and demand economies of scale, and other resource or service complementarities prevailing in the business ecosystems which platforms inhabit (Adner, 2017; Gawer & Cusumano, 2014; Jacobides et al., 2018; Teece, 2018). Thoughtful as they often are, economic accounts of platform behaviour and evolution are predominantly dealing with the business, collaborative and industry logics that drive the diffusion of platforms and their evolution. The economic literature on platforms seldom confronts the particular ways through which these logics become materialized and grounded in the day-to-day operations of platforms and, save one or another exception (Mcintyre et al., 2020) almost never considers how technology is involved in shaping platform operations and sustaining the achievement of their objectives. Not surprisingly so, since logics by implication are concerned with disclosing and accounting for the rationalities (motives, incentives, ends) that underlie the choices of economic actors.

Platforms do not, however, exist into thin air (de Reuver et al., 2018). Instead, their operations are wired in a range of technologies and closely linked to the practices with which the use and management of these technologies are associated. Rather than being merely supportive of pre-existing business objectives, technologies, we suggest, are essential forces that partake in the making of platforms. At a primary level, technologies provide the functional prerequisites and the means through which business objectives are instrumented and achieved. At another and less obtrusive level, technologies shape the

perception of events and opportunities on the part of social actors and circumscribe possible courses of action and intervention (Arthur, 2017; Swanson, 2020). Once perhaps justified on their own, economic approaches to platforms are increasingly ill-tuned to addressing the far-reaching technological developments that shape the services that platforms offer, and the patterns of competition and collaboration with other actors in their environments which the making and trading of these services require (Alaimo et al., 2020 [Paper One]). Platforms are certainly economic entities, but they are as well complex configurations of people, technologies, technology-related skills and solutions that are variously involved in shaping their behaviour. Their evolution can scarcely be accounted for without serious attention to the technological dynamics to which they are embedded (Faulkner & Runde, 2019; Henfridsson et al., 2018; Holmström, 2018).

Some of these issues are variously present in IS-akin approaches that link the behaviour and evolution of platforms to system architecture (Sandberg, Holmström, & Lyytinen, 2020). Most of these approaches feature the concept of modularity as defining architectural principle and focus on the generativity which modular architectures establish as compared with the tight component coupling of integral architectures (Ulrich, 1995). Modular and layered architectures are claimed to provide ample opportunities for bundling and unbundling the components by which they are made and thus expand or contract operations to pursue different paths to value creation and capture (Henfridsson et al., 2018; Tiwana et al., 2010; Yoo, 2013; Yoo et al., 2010). Quick platform scaling (Huang, Basu, & Hsu, 2010; Parker et al., 2016) and the revocable nature of investments or resource dependencies that modular architectures enable support quick platform growth, frequent reorientation and, ultimately, evolution. Certain of these ideas are forcefully pursued in a hybrid literature that draws upon economic and architecturally derived explanations of platforms. In this literature, platform evolution is often seen as

the outcome of various strategies that combine a stable technological core with a variable assortment of peripheral components to promote adjustment, innovation and network building (Baldwin & Clark, 2000; Baldwin & Woodard, 2008; Varian, 2010a). As indicated above, the architecturally grounded conception of platforms has made a historical contribution to our understanding of platforms and the ways technologies and economic rationalities mingle with and draw upon one another. At the same time, such an approach to platforms is too abstract or generic to be able to penetrate the detailed fabric of technologies and technologically mediated operations that sustain platforms as organizations.

Little wonder that the literature on platforms is diverse, multidisciplinary and quickly growing. We can scarcely do justice to the richness and heterogeneity of this literature within the confines of this empirically-based paper (for a more thorough literature review see Alaimo et al., 2020 [Paper One]; de Reuver et al., 2018). Yet, the ideas we sketch above represent important reference points against which we position our own investigation. We view platforms as business organizations that seek economic returns by producing and trading services. In viewing platforms as independent economic entities, we distinguish them from any kind of time-bound arrangements set up to pursue specific objectives within or across organizations such as open innovation, crowdsourcing or product development platforms (de Reuver et al., 2018; Henfridsson, Yoo, & Svahn, 2009). This is a crucial distinction that has to be upheld throughout this paper. Granted the hyper-technological context in which they are embedded (Lyytinen, Nambisan, & Yoo, 2020), most of the services that platforms produce and trade are variously intertwined and often developed and realized through the inventive use of several widely available technologies. The steps by which such technologies are transcribed to specific technologically-defined operations that support the services that platforms produce and

trade require empirical research and theorizing at a level granular enough to unravel the links between specific product and services (e.g. advertising services, booking services) and their technological underpinnings (e.g. viewability and click-through metrics, real-time availability systems and price comparisons). Platforms emerge as distinct organizations due to their capacity to establish these links and embed them in the wider platform and internet ecosystem in which most platforms operate.

The technological fabric of platforms is no doubt complex. It entails the piecing together of many heterogeneous technological elements made of diverse physical devices (e.g. desktop, servers, mobiles) and an equally large and miscellaneous range of software-based systems that are often embedded in wider technological infrastructures that link platforms to their environments and the internet ecosystem (Henfridsson et al., 2018). However, such an image of platforms remains, as noted, rather abstract and hard to link to the day-to-day operations of platforms. The heterogeneous assemblages platforms, we maintain, are routinely set in motion through the very construction, implementation and management of entities that are able to link *generic technological functions* or affordances with *specific organizational tasks* and *business operations*. In the case of TripAdvisor, these entities include, among others, content and commerce links, end-user webpages, reviews and ratings, popularity rankings, reviews overview, price comparisons and booking systems that are all linked with and draw upon one another. Specific platforms, as distinct from the abstract idea of platform, exist as organizations thanks to the omnipresence of these intermediate entities that we will refer to here as digital objects (Faulkner & Runde, 2019; Kallinikos, Aaltonen, & Marton, 2010; Kallinikos, Hasselbladh, et al., 2013). Understanding platform operations and their transformation over time, therefore, requires unravelling the dynamics of these intermediate entities through which generic technological functions or affordances are translated to specific

organizational tasks and processes and, ultimately, to market services. It is through these entities we maintain that platforms sustain their day-to-day operations and link them with the achievement of their wider organizational objectives (Alaimo & Kallinikos, 2020).

Digital objects have so far been theorized at an abstract level that pays heed to their reprogrammability, editability, interactivity and reuse (Ekbia, 2009; Kallinikos et al., 2010; Kallinikos, Aaltonen, & Marton, 2013; Yoo, 2010), attributes that are assumed to distinguish them from the stability, fixity and plenitude of physically-embedded objects. At the same time, the focus on objects redirects attention from generic technological conditions conveyed by such terms as architecture and infrastructural complexity (Hanseth & Lyytinen, 2010; Yoo et al., 2010) to the interaction dynamics between technological components and the social and organizational conditions in which these components are embedded. In this paper, we take these ideas further by considering digital objects as essential building blocks in the making of platforms. Digital objects are essential insofar as they provide the means by which platforms instrumentalize their strategies and demarcate organizational relations, roles, and rules (Borgmann, 1999; Faulkner & Runde, 2019, 2013; Kallinikos, Hasselbladh, et al., 2013). The demarcation occurs by using digital objects as a fundamental means for circumscribing patterns of action and formal organizing and providing the normative pillars upon which platform identity is built (Faulkner & Runde, 2019). Digital platform evolution cannot be fully understood without paying due attention to digital objects and the ways by which they link to and interact with one another to weave the fabric of technological and organizational operations by which digital platforms attain their status and identity in the digital economy.

At the same time, the making of platform operations through the design and use of digital objects is closely associated with the dynamics of digital technology and the entire internet ecosystem. The evolvability of digital objects and their editable and reprogrammable attributes provide the means through which platforms stay attuned with the wider environments in which they operate. The empirical study of TripAdvisor we report below reveals that the platform has transformed over the years from a travel search engine website to a social media platform and, more recently, to a complex and increasingly dynamic service ecosystem. Each of these stages is closely linked to and co-evolves with broader technological conditions such as the development of the Internet towards a real time-based interaction system, and the growing interoperability, interactivity and computational sophistication of digital technologies (boyd, 2015; Zittrain, 2008). However, these latter conditions apply across the board and do not by themselves suffice to explain the evolution of TripAdvisor. Accounting for the transformations of TripAdvisor and its current identity requires delving into the details that have defined its evolutionary path as distinct from that of other digital actors and platforms. It is only by analysing the various configurations of technologies, digital objects, roles and practices characteristic of each stage that a reasonable and specific-enough explanation can be derived. Placed against this background, our study has been designed to address the following research questions:

How does platform organize and instrument their operations through the development and use of digital objects? How do such digital objects confer platforms their distinct identity?

How are the design and use of digital objects linked to the technological dynamics and the evolution of the internet ecosystem?

The ideas put forth so far indicate that economic (industry structure, competition, network effects) and technological (modularity and layering, complexity) conditions matter but the ways they do differ across contexts, time periods and platforms. How platforms evolve requires studying at a close the specific operations that define the identity of a platform and the ways these are linked to the implementation of distinct digital objects, the services that the platforms produce and trade, and their relationships to other actors in their environment (Alaimo & Kallinikos, 2018). At first sight, this may be seen as an issue of choosing the appropriate level of analysis. By zooming into particular details of its digital objects, one can obtain a richer picture of a platform at the expense, though, of studying the broader context into which these details are embedded. What we propose, however, is not a plea to contextual analysis. It is more of a theoretical canon or principle with respect to how such phenomena as platform behaviour and evolution ought to be studied by combining several levels of inquiry. We advocate a shift in perspective rather than merely a shift in the level of analysis. Broader phenomena linked to higher-order explanatory concepts such as platform strategy and technological architecture can be attributed and, to a certain degree, derived from the study of lower-level phenomena or, at the very least, studied in conjunction. We view a non-trivial cross-level investigation (Abdelnour, Hasselbladh, & Kallinikos, 2017; Eisenhardt, 1989; Yin, 2009) that moves back and forth from higher to lower levels of analysis as essential to explain platform evolution.

The empirical investigation of TripAdvisor we report below addresses some of these issues. Through the structural decomposition of the digital objects that comprise the webpage snapshots of the platform over its life course, we map how the operational profile of the platform and its evolution can be retraced to and reconstructed out of the study of the periodic configurations of technological functionalities, digital objects, data,

actors, roles and practices by which it has over the years sought to materialize its objectives.

Research design and methodology

The empirical investigation is a study of the transformation of TripAdvisor's operations as this is documented by the changes which its website has undergone over the years. The study draws on an extensive collection of website snapshots, retrieved from the Wayback Machine, a digital archive of Internet sites. The underlying assumption behind this rather non-conventional data collection and analysis is that changes in the platform's website may be a good approximation of the operational transformation of the platform over time. The assumption is not entirely unproblematic. Website snapshots work as public documents of interfaces through which users engage with the platform. In this regard, they may be biased or not satisfactorily reflect the operational links across several layers of the platform that we claim are essential for understanding platforms. Justified as these issues are, they do not annul the significance of snapshots as empirical testimonies. Granted the central place which users play in most socially oriented platforms such as TripAdvisor, we view the layout and structure of snapshots as a good enough evidence for reconstructing its operational fabric and its relationships with other key actors in its environment.

Websites are a collection of webpages that have diverse modes of being organized. In the case of TripAdvisor's website, webpages are organized as a tree-like structure (Figure 12). In an information hierarchy such as this, the upper levels tend to display an overview of the information displayed in detail at lower levels. In this way, TripAdvisor's homepage is the entry point to the website and provide both an overview of the website and links to lower-level webpages. They, in turn, link to other webpages across several

levels in the hierarchy. Webpages at the same category in Figure 12 (e.g. destination, list of attractions, hotel profile) have the same HTML structure and layout at a given point of time, differing only in the information displayed to end-users. The analysis was conducted for each category of TripAdvisor's tree-like website structure, starting from the homepage. At the lower levels, the first step in the analysis included the selection of the entities to be analysed in each category. The criterion for this selection was the number of snapshots recorded in the archive over the years until January 2019, the end date of our empirical data collection. Thus, two entities for each category in Figure 12 (e.g. destination, hotel profile) were selected. We retrieved the snapshots via WayBack machine API that provides several filter options. We queried two snapshots per day from 2000 until Jan 2019 for each entity. In total, the archive maintains 53,558 snapshots for the selected entities, and we automatically retrieved 15,461 snapshots.
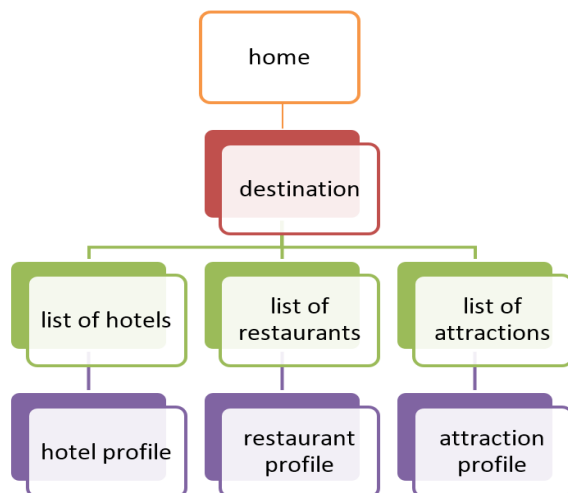
Figure 12. TripAdvisor's tree taxonomy

Due to the significant amount of webpage snapshots, the analysis was conducted using computationally intensive methods, also called digital methods to support both the data collection and analysis. Several studies rely on digital methods to study platforms such as Facebook, Twitter, or Wikipedia (some examples in Berente et al., 2019; Rogers, 2013). Digital methods consist in adapting existent computational techniques to study

phenomenon embedded in digital settings. This is not to imply that the analysis occurs automatically. In fact, the use of digital methods requires a number of essential human activities (Berente et al., 2019) to appropriately adapt and employ computational tools or techniques to the research and the task at hand. We followed four major analytical activities based on Kitchin (2014) and Langley (2000) – sampling, taxonomy formation, pattern recognition and data visualization.

The sampling consists of several tasks, including the selection, collection, pre-processing, and transformation of data. As mentioned, we selected two entities in each category in the tree-like structure (Figure 12) driven by the quantity and the spread in time of the snapshots recorded in the archive. Consecutively, we relied on a Python script explicitly programmed to capture TripAdvisor webpages snapshots automatically and compare the retrieved snapshots. Webpages are, in the computational sense, a set of Hypertext Markup Language (HTML) instructions that browsers render into several digital objects (e.g. social buttons, reviews, etc.) which users interact. The Python script detected and listed snapshots that embedded different HTML structure. To do this, the program reads and compares the HTML instructions of two consecutive snapshots in a point of time. This pre-processing step helped avoid collecting similar pages and thus reduced the number of snapshots significantly, as changes in the HTML code were not frequent. For example, for the home page level, which had 32,771 snapshots (6,056 retrieved), the program detected 1,558 different snapshots. Also, it showed that in several points in time, there was more than one webpage version coexisting simultaneously. These filtered snapshots were furthermore manually compared to create a chronological sequence of changes. For instance, at the home page level, 82 changes were identified out of which only 38 concerned changes related to the introduction of new digital objects, data type or

features. The others were related to changes in the graphic style or the disposition of elements on the webpages.

The careful manual comparison of the snapshots allowed us to develop a *taxonomy* of digital objects embedded on the webpages. We categorized 83 digital objects by identifying the underlying structures in the webpages that endure and by which TripAdvisor instrument its operations (Faulkner & Runde, 2019). We paid close attention to the *functionalities*, *sources of data*, and *practices* involved in digital object creation. To understand in more detail the relevant practices, we complemented webpage snapshots with several online documents from trustworthy sources such as TripAdvisor For Developers or Skift (see for more detail of this analysis in Paper One). Though insightful, the taxonomy itself provides little understanding of the transformation of TripAdvisor's digital objects over time. To do this, we used computational analysis to identify the trends and visualize the empirical data.

We programmed another Python script to *recognize the patterns* of digital object evolution. As we mentioned, the same type of digital objects exhibit the same HTML code lines, so we first manually inspected the HTML code of the webpage snapshots to identify the underlying HTML code of each type of digital object identified in the previous step. By using the HTML code structure of each digital object, the Python script was able to automatically detect digital objects and count their occurrence in a single snapshot. As the number of snapshots available per year is irregular, the program calculated the average values of the occurrences of each digital object per year. These averages were grouped by *sources of data*, and *practice* of the digital objects to get inside of how TripAdvisor website has evolved. Two snapshots per year were randomly selected, and the results of the count and sum were manually checked to test the python

script. The test showed that digital objects had changed their HTML code sporadically over time. These changes are closely related to Web technologies advances. For instance, the development of AJAX technology allows dynamic digital objects by updating them with real-time data. Though visually, the digital objects remain the same, the HTML code structure changes slightly by adding the AJAX instructions that make digital objects dynamic. After validating the results, five more hotel webpages were scraped to cover a more significant spectrum of time, and subsequently, the program was run to the entire population of snapshots.

As mentioned, the tree-like structure tends to display more granular information at lower levels (Figure 12). Compering the webpages of hotel, restaurants and attractions, TripAdvisor's hotel webpages exhibited a wide range of digital objects than others in the same level and upper levels. For this reason, we *visualize the data* of the TripAdvisor hotel webpages by using streamgraphs. This type of graphs enhances the discovery of trends and patterns over time by displaying the variations in values over time across different categories using flowing, organic shapes (streams) around a central base. In our case, we used the *practices* of the digital objects identified in previously. Each stream corresponds to the average occurrence of the practice that underling the generation of digital objects, and the x-axis represents time (see Figure 13). Also, data play a significant role in digital platform evolution (Alaimo et al. 2020 [Paper One]). Based on this premise, we assigned different colours to signal the source of data required to generate the digital objects. For instance, reviews and forum's posts (digital objects) have associated the practice of user-generated content (UGC), and their source is TripAdvisor's users.

Following the generation of the streamgraphs, we superposed the chronological ordering that portrays the changes in TripAdvisor's webpages on the streamgraphs. This facilitated

the identification of periods (see vertical lines in Figure 13 where the digital objects embedded on TripAdvisor webpages remain stable. We were able to identify four periods in the nearly two decades that have passed since the establishment of TripAdvisor to the end date of our investigation.

Results: the pattern of TripAdvisor' website evolution

Our primary results comprise the narrative of TripAdvisor's evolution, and the streamgraph of that shows the change and development of the digital objects underlying that evolution. The narrative is based on the distinct status of the platform in each the four periods identified and describes in detail the digital objects (including their functionality, practices, and data) by which TripAdvisor instrumented its day-to-day operations in each period. The streamgraph provides a visualization of the evolution of TripAdvisor's digital objects regarding their practices and source of data.

Empirical narrative: digital objects, practices, and data

The types of digital objects present in TripAdvisor's website vary over the 18 years since its establishment to the end date of our investigation. We distinguish four periods in the evolution of the platform that signal a specific configuration of types of digital objects. These types are closely associated with particular practices, operations and data by means of which these objects are reproduced. Period 1, from 2000 to 2003, is characterized by the fact that the digital objects are static, and they mainly link to websites outside of TripAdvisor. Period 2 extends from 2004 to 2007 and is marked by the growing relevance of data generated by users on TripAdvisor (e.g. reviews). Period 3, from 2008 to 2012 is distinguished by the generation of dynamic digital objects, derived from the computation of platform footprint of user behaviour and users social networking data (the connections each user maintains with other users). Period 4 extends from 2013 to 2018 and adds in

complexity as digital objects are produced by blending real-time data across several partners' sources, as well as implementing fully personalized webpages. Below we describe each period or stage in some detail.

Period 1: static digital objects and external links

The first period reveals that TripAdvisor was initially no more than a collection of static digital objects that linked widely to external webpages (see Figure 13, orange streams). TripAdvisor webpages were populated by two digital objects: content links and commerce links. To generate these digital objects, TripAdvisor engaged in several computational processes from gathering the external links to displaying both their content extract and link to TripAdvisor's webpage. These processes were neither automatic nor real-time; in fact, they mostly relied on manual processes. Content links aggregated online travel content dispersed on the web on TripAdvisor's website. Each of these digital objects displayed descriptive information about content articles and the article's link. Users by clicking the link were led to the external webpage where the article was. By inspecting the HTML code, we found that these digital objects every time that they were clicked ran a program before automatically opening the external webpage. The program captured the data about the articles that the users clicked. This intermediary program was the rudimentary way to what is automatically done by plugin web analytic tools [17] today.

These digital objects involved manual pre-processing before they were displayed in the TripAdvisor webpages. This manual task consisted of selecting, classifying, and writing descriptive information about external online content. The practice of displaying content

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[17] Web analytics are tools that enable the measurement, collection, analysis and reporting of web data for purposes of understanding and optimizing web usage (WAA, 2008). A popular web analytic is Google Analytics that works by subscription model.

(usually an extract of the content) from another website and its link is technically called web syndication. This practice allowed to generate web traffic between websites.

Commerce links, like content links, displayed a few lines of external content and redirected end-users to the content webpage. However, these digital objects generated a transaction between TripAdvisor and its client, known as click-through or cost per click (CPC). This practice was the primary method used by websites to obtain revenue as the host platform charged an agreed amount with its client for each end-user redirected to the client's website. We found that these links were governed by an in-house program which automatically redirected the user to external webpages based on several parameters. Some of these parameters identified TripAdvisor's client and allowed to add a tracking code that served to track the transaction from both parties (TripAdvisor and its client). Interestingly, some parameters were identifiers of the position on the webpage where the click was generated. The operational process involved the generation of content links is mainly automatized, but it is trigger by an agreement between TripAdvisor and its client.

Though the option to write a review existed from 2001, the first reviews appeared in 2002 and showed significant growth in this period (see Figure 13, green stream). These digital objects began being displaced on the bottom of the webpages. The HTML code showed that reviews encapsulated three elements: a rate, title, and description by which reviewers (end-user) assessed the experience in specific touristic venues. Reviews are what is called user-generated content (UGC) that introduced a radical change in the operations of TripAdvisor. Since then, ordinary people have been able to publish content online that previously was the exclusive domain of professionals (e.g. journalist).

In the beginning, TripAdvisor indexed its venues by static criteria (i.e. alphabetic or by price). However, in 2003 TripAdvisor launched the popularity index, first in this kind in

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the travel sector. This index dynamically ranked hotels based on several data sources about a given destination. The dynamicity of this index was mainly enabled by the constant computation of the end-user rates embedded in their reviews. This index marked the beginning of the production of what we will call *data objects*. Like digital objects, data objects rely upon the intensive computation of granular data that are widely distributed. This is the starting point of dynamic data management techniques that will mark the platform and its evolution from this point onwards. Table 1 below provides a summary of the analysis of the snapshots during the first period.

Table 5. Digital objects listing and categorization, period 1

Digital objects	Sources	Practices	Functionality
Content links	External	Syndication	Procured travel content from travel hubs
Commerce links	External	Click-through rates	Monetization via click-through rates
TripAdvisor Reviews	Internal	UGC	Procured UGC and encoded user experience
Popularity index	Mixed	Dynamic ranking	Up to date index based on user ratings and other data

Period 2: dynamic digital objects and user-generated content

We identify the start of the second period in 2004, and we link it to the growing importance of user-generated content (UGC) and the practices to which UGC is associated on the platform. In 2004 user forums were introduced that enhanced the practice of UGC by promoting the exchange of travel experiences among end-users. This, together with placing user reviews section to a more visible position in the webpage, denoted a shift in the importance of UGC in TripAdvisor's operations. Also, other digital objects that enhanced UGC were implemented, such as *goLists, and Inside*. Like reviews, they served to share and procure collective information about destinations around the world. In the case of goList, end-users, apart from seeing the content, they were able to rate the list from 1 to 5 and see the rating given to the list by other users. During this period, TripAdvisor started to increasingly rely on computational methods of data

aggregation to be able to produce more compelling user interface. This is witnessed by the development of *reviews overview* that counted and averaged ratings given by users into predefined categories (e.g. rate, cleanliness, type of trip). In 2006, each UGC digital object embedded a link to the user's webpage, which displayed user's activities on TripAdvisor such as last visit and contributions (i.e. reviews, posts).

In 2005 *Similar Hotels Nearby* appeared, a hotel grouping produced by a recommender system that filtered items on the basis of attributes such as location and rating. These digital objects relied upon the intensive computation of hotel data that produced data objects. This recommender (Similar Hotels Nearby) displayed a collection of hotels which contained a link to the hotel webpage in TripAdvisor.

In 2006, TripAdvisor embedded third-party graphic advertising (banners) on its website by using new technology. This technology allowed third-party to update and control dynamic content in a predefined section of webpages. A further step occurred when TripAdvisor embedded Google maps in its webpages and dynamically displayed hotel location and rankings on them. Widely known as mashups, this practice created new unique layout or services by blending data, content or functionalities from various sources. Both banners and mashups exemplified the emergence of technological abilities that enabled TripAdvisor to open its website to other actors. Table 6 above provides a summary of the digital objects embedded in the second period's webpages.

Table 6. Digital objects listing and categorization, period 2

Digital Object	Sources	Practices	Functionality
New UGC objects	Internal	UGC	Procure UGC and encode usefulness
Reviews overview	Internal	UGC aggregation	Summarise information, improve readability
End-User webpage	Internal	User profile	User retainment and engagement
Similar hotels nearby	Internal	Item recommender	Filter hotels based on their attributes
Banners	External	Embed third-party web object	Monetization via advertising
Hotels map	Mix	Mashup third-party web object	Expand search capabilities

Period 3: Interactive digital objects and social networking data

We associate the starting point of the third period with the arrival of a new website design that introduced several changes in 2008. These changes linked to the diffusion of data practices that filtered content to users. The filters, based on user attributes, derived from the footprint of user actions on the platform or relationships to other users in TripAdvisor but also other social media (see Figure 13: third period). The digitals objects derived from such practices drew mainly on sophisticated recommender systems called collaborative filtering and social networking data from Facebook. Collaborative filters inaugurated recursive interaction with users by predicting and feeding back to them what they might like, based on their similarity to other users (blue streams). Examples of these digital objects are: *Recently Reviewed* and *Travelers Also Viewed.* The first displayed a list of ten hotels that received a review recently by users. The second one aggregated hotels on the basis of the past behaviour of other users who had viewed the hotel that the user in question was considering.

In this period, the *Friends Content Summary* and *Friend Activity* digital objects emerged that instantly requested and displayed information about the travel experiences of friends. The data that accounted for the connection among users are what is commonly called

social networking data or social graph. This marked a substantial change in how webpages were generated by developing new digital objects that computed social networking data. This meant the content in each webpage was retrieved depending on who logged on and her/his connections. The *Friends Content Summary* retrieved the reviews given by the user's friends concerning the location that the user was viewing. The *Friend Activity* entity enabled users to view their friends' activities and the most popular location among the user's friends. The second implied an aggregation of destination based upon where the user's friends have been. Data on user friends and locations were initially generated on TripAdvisor's site. After the partnership with Facebook, TripAdvisor used data procured on Facebook, via Facebook social graph API, to derive these digital objects. Data objects were able to store and transmit through JavaScript Object Notation (JSON) files that emerged in 2000 and were first standardized in 2013.

During this period, TripAdvisor developed a social button, a native practice of social media (e.g. the Facebook like button). This was the helpful button that accounted for user votes concerning the usefulness of a review, providing a way to compare and, ultimately, commensurate reviews. At the end of this period, social buttons from other social media platforms (Facebook, Twitter and Pinterest) emerged on the website. These buttons embodied one HTML instruction that enabled the connection between both platforms. By this instruction, TripAdvisor sent the webpage's link where the click occurred to the button's platforms, allowing TripAdvisor to distribute its content. At the same time, this instruction served TripAdvisor to encode user preferences outside its own platform. Table 7 below provides a summary of the digital objects presented in the platform webpages during the third period.

Table 7. Digital objects listing and categorization, period 3

Digital objects	Sources	Practices	Functionality
User contribution	Internal	Gamification	Display the level and the number of user contributions
Recently Reviewed and Travellers Also Viewed	Internal	Collaborative recommender	Filter hotels based on similarity with other users
Friends content summary and Friends activities	Mix	Social graph personalization	Filter reviews based on the user's social graph and footprints
Most popular friends' destination	Mix	Social graph personalization	Filter user friends' preferences
Helpful vote	Internal	Social button/social data	Assess the usefulness of reviews
External social buttons	External	Portable social button	Encode and content distribution

Period 4: real-time digital objects and personalization

We single out the beginnings of the fourth period in 2013, and we connect it to the consolidation of personalization and the expansion of real-time data blending operations. These operations have been the basis for deriving personalized services and also structuring relationships to partners and third parties. Personalization is built on the idea of bringing a more in-depth web experience for each user through predictive techniques. This practice entails the generation of dynamic webpages that derive from known attributes, behaviours and choices of users and entail constant adaptation to the user via machine learning. TripAdvisor developed several digital objects following this personalization logic. Among them, the most significant it was the "*Just for You*" index. By computing the online footprint of a user's actions, "*Just for You*" delivers personalized hotel lists whenever a user searches for hotels in a given destination. "*Recommended for you*" entities follow the same logic as "*Just for You*", aggregating hotels based on a user's actions and characteristics and displaying a list of five hotels. Another entity, *"Hotels you've viewed"*, displays, as the name implies, a list of three hotels that have already been checked by a user. Personalization reaches further. Since the end of 2018, the homepage has been fully personalized according to each user via the *Travel Feed*, signalling a radical change with respect to how interaction with users is conceived. Similar to the Facebook

newsfeed, *Travel Feed* displays content or posts from users, influencers, sizeable online media platforms that a user follows. TripAdvisor partnered initially with more than 500 content providers (i.e. National Geographic, GoPro, the Travel Channel). Three new social buttons emerged at this stage. Follow button enabled users to see the content generated by a user in his/her *Travel Feed*. Repost and share buttons allowed users to disseminate reviews or other content.

In a sense, personalization continues and expands the web practices introduced amass during the third stage. What further distinguishes the current stage of the platform from previous ones and gives it a specific flavour are a series of features that transform user interaction from a data-producing practice (UGC and networking data) to a transaction-enabling experience, mediated by price comparison and booking. *Hotel Price Comparison* digital object match real-time pricing and availability from several vendors with user reviews and opinions in a simple layout. Through this, end-users can compare the prices offered from different vendors for the same hotel and book it at a glance without the need to check different pop-ups as it was the case before. Users who click on a vendor option in the *Hotel Price Comparison* are redirected to the vendor's booking webpage where they can complete the booking. The ordering of booking options in the *Price Comparison* is orchestrated by in house real-time bidding technology in which all the vendors can participate. Since 2015, *Hotel Price Comparison* extended its functionality by making it possible for end-users to complete the entire booking process without leaving the TripAdvisor platform. This required the development of technological abilities to exchange real-time data about rooms and payments. The ordering of booking options is ruled by a commission modality that establishes how many times a vendor booking option is displayed in the first position at the *Price Comparison*. Both modalities (biding and commission) coexist together, revealing a rise in the complexity of operations

and the management of interweaving real-time transactions messages and data flows amongst the vendors. In 2016, the "*Best Value*" Index became the default way to sort hotels in a given destination. This index blended data provided by booking partners and TripAdvisor data such as user ratings, booking popularity, location and personal users preferences. In 2018, TripAdvisor implemented "*Most Booked Properties*" digital objects that display four hotel entities by blending transactional data and TripAdvisor data. Contrasting with the previous digital objects, these ones rest upon the aggregation of hotels based on transactional data, user past actions and social data.

Apart from personalization and real-time digital objects, other digital objects produced by the intensive computation of data and content arrived in this period. *Room tips* digital objects filter reviews that have in their content some allusion to room characteristics. To do this, TripAdvisor probably deploys text mining technologies that enable to extract and process text to predict classification automatically. Reviews in this period began to be collected outside TripAdvisor and displayed with the label *"Review collected in partnership with*". To achieve this interoperability, TripAdvisor developed an API that now governs the flow of data and collaboration with other actors in its ecosystem. Table 8 below provides a summary of the digital objects generated during this period.

Table 8. Digital objects listing and categorization, period 4

Digital objects	Sources	Practices	Functionality
Just for you	Internal	Personalization	Hotel index based on user digital footprint
Recommended for you	Internal	Personalization	Filter hotels based on user digital footprint
Hotels you've viewed	Internal	Personalization	Filter hotels based on user digital footprint
Room tips	Internal	UGC filter	Filter reviews based on the content (room)
Travel news feed	Mix	Personalization	Personalized content by using user digital footprints, social data and social graph the sources are from the user and TripAdvisor content partner
Follow, repost and share	Internal	Social buttons	User graph and disseminate content
Hotel Price Comparison	External	Real-time metasearch	Displays real-time hotel prices and bookings options
Best Value Index	Mix	Hybrid index	Hotels index based on social and transactional data
Most booked properties	Mix	Hybrid Recommender	Filter hotels based on social and transactional data
Third-party web objects (Viator tour booking, OpenTable restaurant reservation, Deliveroo food delivery, Locu restaurant menu, Uber)	Mix	Mashup	Extend services on TripAdvisor travel entities in what it called end-to-end services

Streamgraph: The evolution of digital objects

The streamgraph below shows the pattern of the evolution of digital objects that we derived from the analysis of the snapshots of the hotel webpages (Figure 13). Each stream represents the practice used in the generation of the digital objects identified in the previous section (column practices in Table 5, 6, 7, and 8) and its development over time represented by the x-axis. The stream thickness shows the average occurrence of digital objects by practices per years. The colour of each stream depends on the source of data involved in the generation of digital objects. Orange streams are the digital objects that use external resources for their production. Green represents the digital objects that are built on resources procured from TripAdvisor itself. Purple signs are more complex digital objects produced by creating data objects from a different type of data available

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on TripAdvisor. Yellow reflects the digital objects that are produced by the direct interaction of third parties in the webpages.

The streamgraph (Figure 13) in the first period shows that hotel profiles were mainly built by digital objects that aggregated content from external websites, using syndication and click-through practices. The green stream reveals that end-user did not engage in the practice of UGC by which end-users share their travel experiences. It took approximately four years for this practice to get rooted in end-users. UGC reached its peak during the second period. The development of UGC digital objects added a new role to end-users as content providers. In so doing, end-users were able to transit from the role of content consumer to providers with a few clicks.

The proliferation of UGC triggered some changes on the TripAdvisor website. TripAdvisor began to produce digital objects based on the practices of UGC aggregation and item recommender that produced elementary data objects (purple stream). These events denoted an increase in UGC operations and shifted the platform from a content aggregator to UGC platform. However, syndication and click-through practices continued to play a considerable role (orange stream) even during this period.
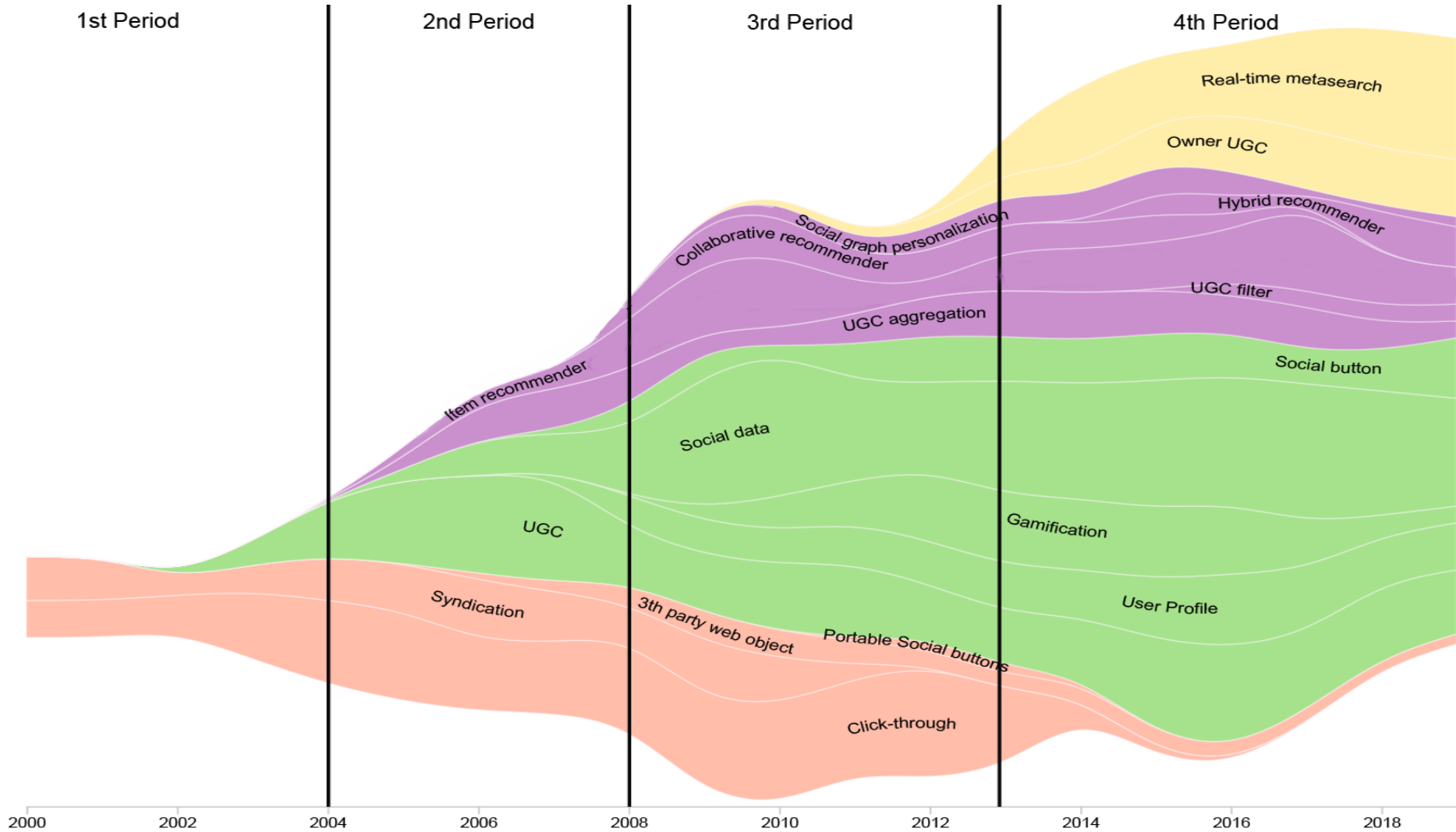
Figure 13. The evolution of hotel-level digital objects

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The third period shows a considerable increase of digital objects that rely upon intensive computational operations of user digital footprints, social data, and social graph (purple stream). Though the previous period attests to the recording of user actions, the boost of collaborative filtering and social graph personalization, this period denoted a shift from the mere procurement of these data to produce and distribute data objects. These data objects are closely related to technological advances (i.e. collaborative algorithms, JSON) that create, process and exchange data objects such as social networking data and user profiling data. The last type of data is dynamic data objects that result from the intense computation of user's activities, interests, and connections. The computation produced an instant profile of the users that changes by any click of the users individually and the activities of others with which the users are networked. Technological advances also enhance interconnectivity among social media platforms. Facebook plays a vital role in developing the TripAdvisor "Friends" digital objects as Facebook share users' social networking data via its social graph API. Also, TripAdvisor interoperates with other social media platforms (Twitter, Pinterest) via these platform social buttons (orange stream).

Apart from social media platforms, business owners, for the first time, were able to directly interact in the webpages with end-users by commenting on end-user reviews (Owner UGC in the yellow stream). After the consolidation of UGC in the previous period, syndication practices considerable decreased (orange stream). All these changes suggested that TripAdvisor operational identity shifted to what today is commonly identified as social media. This change was mainly driven by the developing technological capabilities to create, process and exchange social networking data and user profiling data.

Complexity rose significantly during the fourth and last period of TripAdvisor's evolution. The streamgraph fourth period (Figure 13 fourth period) shows a broader arrangement of digital objects that bore in complex and dynamic data structures. Real-time metasearch (yellow stream) that displays real-time hotel prices and allows users to book has emerged, while the click-through rate as a data practice nearly disappears (orange stream). This change moved the role of Online Travel Agencies and business owners (hoteliers) from mere content providers to real-time bidders, giving their actions and decisions a direct impact on what webpages display.

The dissemination of the transactional booking services positioned TripAdvisor as one of the dominant actors among giants OTA like Expedia and Priceline holdings (Forbes, 2016). This created the impression that TripAdvisor was changing its identity from a social media platform to a booking platform. However, TripAdvisor, probably to counteract this impression, launched the *Travel Feed* with the title "*The New TripAdvisor Goes Social, Gets Personal*" (TripAdvisor 2018). *Travel Feed* only is generated when a user has logged in, and the snapshots were captured as anonymous. We logged in TripAdvisor's website to compare the layout and HTML structures of the direct observation with the snapshots. This comparison revealed that the homepage had undergone significant changes which were not visible in the snapshots. In the case of snapshots from the lower level in the tree structure (see Figure 12), the changes though were not visible in the layout, they were in the HTML code. In so doing, we were able to trace them.

In this period, though it is a clear boost of real-time transactional functionality (yellow), "social" ones are still at the core of TripAdvisor's operations (purple and green streams).

Analysis of the Findings

The patterns of TripAdvisor's evolution we infer from the analysis of website snapshots conforms to four distinctive configurations of digital objects (see Table 9 below). These configurations foster specific forms of user participation under business objectives that considerably impact upon the behaviour of users or platform participants (Alaimo & Kallinikos, 2017; Shah, 2019). Each of the four configurations is furthermore linked to different *operations and practices* that confer the platform its distinct identity. These operations and practices are furthermore bound up with a different individual or collective *actors* and the *roles* they perform in the platforms and its ecosystem.

The first configuration of TripAdvisor digital objects, we associated with an operational profile as a content aggregator (see Table 9). In this period, digital objects were predominantly linked to external webpages by which TripAdvisor aggregate the spread travel content in a single place. Users by clicking the links were led to the external webpage that it is technically called "lead". The generation of these leads was possible technologies that enable web syndications and click-through rates. These practices confer the role of content consumer to end-users and content provider to TripAdvisor's clients. Web syndication and specially click-through rates in some sense set the basis of the digital economy by increasing and monetising the web traffic.

The second configuration of TripAdvisor we link with the operational profile of a user-generated content platform (see Table 9). The shift from the first to the second configuration coincides with the enormous engagement of users in generating content (e.g. reviews and ratings) that cause a change in the end-user webpages interfaces. These changes set a new form of participation that favoured the role of end-user as a content generator while keeping their role as a content consumer.

Though UGC digital objects were embedded in the website from its very beginning, the peak of their use occurs in the second period. This denotes the gradual and bidirectional process by which such digital objects and the patterns of action to which they are linked diffuse throughout the web and become the norm by which users are linked to the platform (Faulkner & Runde, 2019; Kallinikos & Hasselbladh, 2009). The relevance acquired by UGC digital objects was evidence by the decline of content link and the development of new UGC digital objects. This important upshot of events signalled the central role which the operations and practices of UGC acquired in the life of the platform, a role that continues to remain essential to the public image of TripAdvisor and a pillar upon which further transformations have relied.

The third configuration of the TripAdvisor's website, we associate with the operational profile of a social media platform (see Table 9). In this period, a number of "social" digital objects were developed. These objects introduced new stylised forms of end-user interaction that is commonly is linked with social media (Alaimo & Kallinikos, 2017). These digital objects signalled the development of operations to crunch and trade data about end-users activities, interests, and connections (Alaimo & Kallinikos, 2016, 2017; Gerlitz & Helmond, 2013; Gillespie, 2014; Helmond, 2015). These "social" digital objects served to trace every click that end-users did on the basis of which dynamic data objects were produced. For instance, user profiling data and social graph data. In so doing, end-user clicks became the asset through which the platform sustained its operations and attained its status. These operations required a set of new technological capabilities to deal with the intensive flow and processing of data. However, these capabilities build up in capabilities that the platform developed in previous stages of its evolution. While in the second period, the platform developed capability to track, record and storage data

about user actions and interests, during the third period moved to methods of procuring and crunching such data.

Contrasting to the previous transition that was triggered by end-user engagement and UGC, the transition from the second to the third configuration was mainly fostered by the development of new technological capabilities to "making the Web social" (van Dijck, 2013). These capabilities, in reality, means "making sociality technical" (van Dijck, 2013) by an intricate apparatus of data crunchy (Alaimo & Kallinikos, 2017, 2020). This shift probably obeyed to the ever-present need of the platform to tune with its environment (Eaton et al., 2015).

The fourth and last configuration of TripAdvisor has ongoing significant operational changes (see Table 9). These changes are recent to infer a new operational profile. In this way, we denominated as a hybrid profile to signal the boost of transactional operations while maintaining its "social" operations. This period is characterized by the development of real-time digital objects that constitute the basis on which TripAdvisor moved on to new operations of transactional and commercial nature. These objects have brought onstage new actors that interact directly with the webpages. Vendors, including OTAs and businesses' owners, were able to access real-time booking options and bidding, conditions that granted their actions and decisions a direct impact on what webpages display.

The emergence of booking and end-to-end digital objects denoted a dramatic change in TripAdvisor operational identity by selling travel services on its website, adding the role of customers to end-users. However, after five years from the emergence of these digital objects, *Travel Feed* arrived, a full personalized content and data service much like Facebook's newsfeed. The development of these digital objects brought a new type of

actors – content providers such as National Geographic and GoPro – that directly interact with the webpages, further increasing the operational complexity of the platforms and its dynamism. The Travel Feed, at least at first sight, may denote a move back to what commonly is known as social media platforms. However, these changes still are too recent to assume that they are embedded in stable and durable structures.

Table 9. Digital objects evolution, operations, actors, roles and identity

	Content aggregator	UGC platform	Social media	Hybrid (social media and transactional)
Digital objects	Predominantly statics digital objects (links to external webpages and reviews)	Predominantly dynamics digital objects (forums, wiki, and goList, reviews overviews, item recommender and maps)	Predominantly interactive digital objects (social buttons, personalization, and collaborative recommender)	Predominantly real-time digital objects (room, table and tour booking, price comparison and travel feed)
Operations and practices	Generations of leads to external webpages by using technologies of web syndication and click-through rate	Procurement of UGC and production of basic data objects by using technologies that enhance UGC aggregation and item recommender	Capture of data about user actions, interest and connections by producing dynamics and instant users' profile	-Real-time Transaction (bookings and biding) -Real-time content (Travel feed) -Real-time data exchanges (prices, availability, menu)
Actors and roles	*End-users*: content consumer *Clients*: content provider	*End-users*: content consumer and provider *Third-party*: content providers	*End-users*: product by clicking *Social media platform*: data exchanged *Owners*: content provider	*End-users*: costumers end-to-end services (booking reservation, delivery) *Vendors and hotels owners*: data providers and bidders *Media partners*: content provider

Discussion

The results of our empirical analysis lend support to the original assumption concerning the role which technologies and technological objects play in the orchestration of platform

operations. Our reconstruction of the evolution of TripAdvisor shows that the transformations which the platform has undergone in its life course are closely associated the technologies and data practices that sustain the detailed fabric of platform work and the ways they change and adjust to one another. These transformations are obviously associated with wider technological developments as well as with changes in the business ecosystems into which platforms are embedded. Yet, none of these wider architecturally based and economic explanations suffices to account for and demonstrate the detailed fabric of these operations and unravel how these transformations happen. Such a task requires insight at a much more granular level at which platforms are constituted as operative systems by the construction of several technological objects that are linked together through several practices. In what follows, we provide a more thorough interpretation of our findings and spell out their theoretical relevance.

Our analysis indicates that each one of the four stages we have identified in the evolution of TripAdvisor is marked by a specific configuration of business operations, digital objects, data sources and types, and data practices. The structural analysis of the webpages of the platform we have undertaken suggests that digital objects perform critical functions that sustain the business operations of the platform. Each one of these objects and operations is integrally linked to particular data sources within or outside the platform, makes use of different types of data that feed on particular objectives and data practices such as compiling and indexing information, tracking user behaviour and filtering information, personalizing services and collaborating with other actors and personalizing user interaction.

Our analysis also shows that these configurations change as some technological objects and the functions they perform become obsolete, lose relevance or recede into the

backstage due to wider technological changes and shifts in organizational practices and business models (Henfridsson et al., 2018; Kallinikos & Hasselbladh, 2009; Mcintyre et al., 2020). Broader shifts in technologies in particular refigure the types of digital objects platforms deploy, and the practices associated with the use and management of these objects. Contextual advertising, for instance, is done very differently today compared to the early years of TripAdvisor in which static web content and a predefined list of advertisers were linked to the user search. Click-through rates have largely given way to auctions and commission-based models of monetization. Other technologies and functions, however, have migrated in different versions or formats and continue to play an important role across the four stages identified. This is the case with the digital objects we subsume under the names of *popularity index, most popular* and *best value index*. The same holds true for reviews and ratings which were introduced relatively early in the life cycle of the platform, yet continue to grow in significance and used in novel ways to support a variety of operations and service offers. Rather than seeing these stages, therefore, as discrete and discontinuous steps of succession in a linear track of platform evolution, it is best to look at each one of them as ensembles or setups of functions and data practices that rely on, take stock of and variously ride or transform earlier technologies and data practices. These ideas are supported and illustrated by the streamgraph (Figure 2 above) that provides a visual representation of the chronological unfolding and relative significance of these technological objects, functionalities and practices across the four stages (see also Alaimo et al., 2020 [Paper One]).

At the same time, the comparison of the early years of TripAdvisor with the current stage of the platform reveals far-reaching changes that require some commentary or explanation. The careful reading of the empirical results and the streamgraph yields a few interesting observations that may seem to provide the bottom line of the empirical data

we have extracted from the structural analysis of the snapshots of TripAdvisor's webpages and the transformations they have undergone over the platform's life course. In one way or another, the evolution of the platform is inextricably bound up with the ever-present quest to achieve a tuning with its environment (Eaton et al., 2015) that approximates *real-time interaction* with users and other key business actors. Such an objective is closely linked with the organizational and technological ability to collect and cope with constantly updatable and increasingly diversified data sources and share, exchange and use whatever analytic results can be extracted from such sources. The transformations which the *popularity index* has undergone since it first appeared in 2003 to its current shape as *best value index* is perhaps the most conspicuous response to this inexorable quest of interacting with users on real-time through the ability to collect, combine and crunch diverse and constantly updatable data sources (Alaimo et al., 2020 [Paper One]; Helmond, 2015; Yoo, 2013).

Real-time interaction with users that draws on several and constantly updatable data sources enables new forms of user involvement that *enrich user experience* on the platform substantially. In fact, the evolution of the platform over the years can be read as the steady expansion of user experience, both in terms of forms of user engagement (what users can do themselves and in tandem with their social media connections) and in terms of the services available to them such as price comparison and booking. None of these vital objectives can, however, be accomplished without broader patterns of *collaboration* with other actors of the digital world and beyond, such as social media platforms, online travel agencies, hotels and hotel chains, restaurants and dining platforms or analytics companies. Such collaboration, in turn, requires the skilful use of boundary technologies such as social buttons and APIs (Eaton et al., 2015; Ghazawneh & Henfridsson, 2013; Henfridsson et al., 2018) and considerable in-house IT capacity to deal with and

innovatively use data. To build up and expand the services TripAdvisor currently offers calls for high computational sophistication through which data can be interrogated, shared, transferred, aggregated and mashed up and generally made available for whatever operations is possible to perform with and through them (Alaimo et al. 2020 [Paper One]). Again, *best value index* is the most conspicuous manifestation of these trends.

As mentioned above, the changes we have identified in this paper are closely associated with and variously co-evolve with the wider technological developments such as the interactive transformation of the Internet and the diffusion of social media (boyd 2015) and, crucially, the growing sophistication of computational methods and machine learning (Kelleher & Tierney, 2018; von Krogh, 2018) that underlies many of the customized and personalized practices of TripAdvisor. Though we did not say very much in this paper, much of personalization is supported by machine learning that constantly tunes the algorithms that filter data and advance personalized recommendations to user preferences and actions. Yet, it would be a huge mistake to assume that TripAdvisor and other successful digital platforms are the mechanical outcomes of these comprehensive technological shifts. Such broader developments matter and produce economic returns only when they are skilfully transformed into specific services, rich enough to improve user experience and expand interaction with other actors in the platform's environment. *Best value*, to refer to the same example, is not simply explainable by recourse to concepts such as machine learning and buzzwords such as algorithms and algorithmic management (see more on this in Kallinikos & Constantiou, 2015). Best value is a specific technological object and a particular practice in a specific industry through which different types of travel-related data are brought to bear upon one another via several other technologies and operations that collect, tidy, standardize them and render them ready for algorithmic processing.

Such technologies and data practices are no doubt guided by strategic intentions and can, therefore, be linked to platform strategy and other higher-order concepts (Gawer 2014; Jacobides et al., 2018). Yet, a fuller understanding of them requires insight into how strategic intentions are materialized by setting up and managing a complex system of operations whereby technological functionalities, web entities, data sources and data practices can be linked to the pursuit of economic returns.

Conclusions

In this paper, we have approached platform evolution though the decomposition and analysis of webpages. We have in particular looked at the evolution of TripAdvisor through a historical analysis of the structure and layout of its webpages from its establishment up to January 2019. Through the analysis of the empirical data, we have identified four distinct stages in transformations the platform has undergone. Each one of these stages variously combines technological objects and functionalities, data practices and economic operations.

The key findings of our research lift up the overlooked role which lower-level processes play in materializing strategic intentions and shaping the operational profile of platforms. In the hyper-technological world that characterizes our time, strategic intentions and technological capabilities, business orientations and technological practices are inseparable. In fact, one could go a step further and claim that economic organizations such as the platforms that dominate the current world are the cumulative outcomes of the complex interplay of a host of economic and technological factors among which strategy is just one and, perhaps, the least important. By claiming that lower-level processes play a crucial role in shaping developments at a more abstract or higher level such as the distinct profile of platform operations, platform strategy and evolution, we do not

advocate a causal link. We only argue that a richer understanding of platforms and the mutations they undergo over time cannot be achieved apart from tracing the connection of these mutations with the techniques, data sources and data practices by which they have been realized (Alaimo et al., 2020 [Paper One]). Needless to say, a more adequate understanding of the pattern of transformations platforms undergo calls for further research beyond singles cases and ideally comparisons across platforms and industries.

Chapter 4

Boundary-Making in Platform Ecosystems – The Case of TripAdvisor

Abstract

This paper focuses on boundary-making in platform ecosystems. We conduct a longitudinal case study of TripAdvisor (2000-2019) to investigate the mechanisms of boundary-making that the platform uses to orchestrate relations with its external environment. Our narrative recounts the story of the many mechanisms (i.e. partnerships, acquisitions, commercial agreements, "plug-and-play" solutions) with which TripAdvisor has been able to establish, govern and grow its now rich ecosystem. The case documents the technologies used as boundary resources and examines the role of such technologies in shaping drivers and mechanisms of boundary-making. Our findings unravel the variety of boundary-making mechanisms and drivers in platform ecosystems and point to the fact that technology has a much greater role in shaping boundary-making strategy and in accelerating change in the ecosystem configuration. Drawing from a richer theoretical account of how platform organizations interact with their environment, we expand the definition of boundary-making and we propose a revised role for boundary resources. This we argue, may contribute to the understanding of governance mechanisms in platform ecosystems and shed light on little known dynamics of value creation and value capture which extend beyond the platform-developers dyad.

Keywords: *Platform ecosystems, Platforms, Boundary-making, Boundary Resources.*

Introduction

Boundary-making has been a central concern in organisation studies and management literature. It refers to the modalities by which formal organisations establish a relationship

with their environment and studies how this relation evolves enabling organisations to benefit from external resources yet maintaining a degree of autonomy from external influences (Aldrich, 1979; Santos & Eisenhardt, 2005; Scott, 2008; Thompson, 1967). As novel organisational arrangements such as digital platforms become dominant, boundary-making acquires new relevance. Studying how a platform engages in boundary-making activities and how such activities evolve over time, becomes of capital importance as it means to understand how a platform interacts with external actors forming its varying ecosystem configurations.

The study of boundary-making in digital platforms and platform ecosystems has so far predominantly focused on the relationship between platforms and third-party complementors, which are often equated with developers (e.g. Boudreau, 2010; Ghazawneh & Henfridsson, 2013; Ondrus et al., 2015; Parker & Van Alstyne, 2018a; Wareham et al., 2014). Such an approach, however, limits the variety of external actors that interact with platforms to one (often ill-defined) category often reducing the study of boundaries resources to the specific technologies such as APIs and SDKs which are used to govern the relationship between platform owners and third-party developers (Eaton et al., 2015; Ghazawneh & Henfridsson, 2013).

Albeit important, the focus on developers or complementors has somehow constrained the conceptualisation of boundary-making and boundary resources excluding a richer set of technologies and mechanisms with which platform organisations establish and govern the relationships with their external environment (Gawer & Cusumano, 2014; Gorwa, 2019; Skog et al., 2018). Digital platforms have grown into ecosystems by developing and orchestrating a much broader and complex set of links using several mechanisms of boundary-making and a number of different boundary resources. Significant relationships

have been forged with networks of advertisers, with hundreds of content procurement websites and with data partners or brokers using widgets, RSS technology and a variety of web objects (i.e. social buttons, web banners, plugins and extensions) which have effectively acted as boundary resources governing the exchange of various digital assets across platforms. Without these relationships, the majority of digital platforms today, included Facebook and Google, would not have been able to capture value. Likewise, the boundary resources and related mechanisms with which platforms manage the relationship with their end-users have been so far little explored (see Alaimo & Kallinikos, 2017; Gerlitz & Helmond, 2013), yet it is now common to consider end-users as external agents involved in platform's value creation (see i.e Srnicek, 2017; Zuboff, 2019).

Expanding the conceptual toolkit on boundary-making, we argue, opens up our understanding of governance mechanisms in platform ecosystems and may enlighten on little known dynamics of value creation and value capture which extend beyond the platform-developers dyad. We conduct a longitudinal case study of TripAdvisor (2000-2019) with the aim to investigate boundary-making and how it relates to platform ecosystem evolution. We use a number of data sources to illustrate and categorise all the mechanisms used by TripAdvisor to orchestrate the exchange of resources with external actors along with the (almost) twenty years of the platform's activity. We document the technologies used as boundary resources, and we examine the role of such technologies in shaping drivers and mechanisms of boundary-making. As our study documents, technology has a much more significant role in determining both drivers and mechanisms of boundary-making. Drawing on our findings, we propose a revised and expanded definition of boundary-making and boundary-resources on platform ecosystems. We

further contribute to the literature on platform ecosystems by linking boundary-making to platform ecosystems change and evolution.

Literature review and positioning

Boundary-making has always been a central concern in organisation studies and management literature. It refers to the modalities by which organisations establish a relationship with their environment and studies how this relation evolves enabling organisations to benefit from external resources yet maintaining a degree of autonomy from external influences (Aldrich, 1979; Santos & Eisenhardt, 2005; Scott, 2008; Thompson, 1967). In general, boundary-making implies making a distinction between what is out and what is in the organisation and involves establishing an authority, roles and a structure to exercise control over such distinction such as for instance between members and the complementary set of non-members. The modalities with which this distinction is implemented substantially differ across organisations, but the ability to control boundaries remains critical for the maintenance of organisational autonomy (Aldrich, 1979). Boundary-making does not necessary involves formal structures of authority and control as boundaries have been studied often as not fixed and dependent on the specific situation organisations face. Despite the physical situatedness, the concept of boundary may be associated with, organisational boundaries are first and foremost cognitive means through which organisations separate themselves from their environments. Even in the study of formal organisations, locating organisational boundaries is often problematic as organisations are complex social entities whose structures and configurations often vary (Aldrich, 1979; Thompson, 1967). Boundary-spanning and boundary-maintenance, for instance, the expansion and contraction of organisational boundaries, are just the two extremes of a range of common strategies that organisations facing internal or external threats may adopt.

Building on IS, organisation studies and related disciplines we broadly define boundary-making as the socio-technical shaping of the demarcation of an organisation relative to its environment. Boundary-making is an essential activity of control and governance of external and internal resources and therefore of relations with a set of actors (complementary and non) operating in the organisational environment (Aldrich, 1979; Santos & Eisenhardt, 2009, 2005; Scott, 2008). Beyond the contingency approach of what can drive a specific organisation to adopt boundary-maintenance or boundary-spanning strategies, boundary-making activities in organisations can be associated to the presence of more general drivers such as organisational structure or modality of control. The presence of specific organisational structures of control such as, for instance, normative, utilitarian and coercive structures (Etzioni, 1961) has been studied as steering boundary-making in specific directions. Looking at the association of boundary-making with modalities of control appears as particularly promising for digital platforms as the concern over how do they exercise control is central for both their establishment and evolution (Gawer, 2009; Gawer & Cusumano, 2014; Tilson et al., 2010; Yoo et al., 2010). Despite the relevance of technology in organisations and its tight coupling with control, we do not know much about its role as a driver of boundary-making. For instance, technological-enabled control has been studied in terms of clashes arising from its coexistence with pre-existing mechanisms and structures of control in the organisation (i.e. the clash between formal structures of control vs technology-as-control, see for instance, Kallinikos, 2011; Kallinikos, Hasselbladh, et al., 2013; Lessig, 1998; Zuboff, 1988).

Different control-structures can co-exist in organisations and operate as drivers of boundary-making simultaneously or at different points in time Santos and Eisenhardt (2005), for instance, present a typology of boundaries determined by key drivers of efficiency, power, competence and identity. Such drivers can co-exist and overlap. Also,

their distinction has much in common with the determinants of boundary-making activities mentioned before. For Santos and Eisenhardt (2005) boundaries of efficiency mostly derive from utilitarian conceptions of strategy such as, for instance, minimising governance costs. Boundaries of power derive from structures of coercive control over members or resources and hierarchical or central structures to reduce the dependency of the organisation from the external environment. Within this category, we may include, for instance, a set of boundary-spanning activities as acquisition or co-optation of challengers (see, e.g. Aldrich, 1979). Santos and Eisenhardt remark how *nonownership* mechanisms such as alliances and friendship ties with competitors can be equally considered as the offensive use of boundaries (Santos & Eisenhardt, 2005, p. 496). Boundaries of competence are driven by the gathering and exploitation of competences, skills and resources or by the creation of dynamic capabilities, all activities that are necessarily tied up to the distribution of resources in the environment (Thompson, 1967). Boundaries of identities are tightly coupled with normative roles and rules. Boundaries of power and boundaries of identities can be both inscribed to the normative category of organisational control structure proposed by Aldrich (1979), drawing from Etzioni (1961).

On platforms, value is increasingly created outside the boundaries of the firm, within their external environment. Platforms have been defined as "inverted firms" (Parker et al. 2016) that thrive on resources, included knowledge and innovative capabilities, which are produced across large ecosystems of heterogeneous actors composing the organisation's external environment (Gawer, 2014; Gawer & Cusumano, 2014). The literature on platforms and platform ecosystems boundaries has mostly evolved around the boundary of efficiency (transactions) and boundary of competence (resources or innovative capabilities) reducing control to a narrow concept applied either to transactions or

exchanges or to the governance of arm's-length relations between a focal platform and complementors. Boundary-making on platforms has been essentially confined to efficiency and competence partly because of the dominant definitions and conceptualisations of platforms which have been so far ruled by the economics and engineering perspective (see Gawer, 2014). The economics perspective views platforms as multisided markets which facilitate the transaction between consumers and producers (Evans & Schmalensee, 2016). Network effects are the central features of these organisations that thrive by facilitating matchmaking between sides and by orchestrating exchange of external resources. The engineering perspective sees platforms as technological designs that organisations use to facilitate the development of new products. Under this approach, platforms are modular architectures made by a stable core and peripheral modules (Baldwin & Woodard, 2008). The flexibility afforded by peripheral modules is able to foster innovation largely because it involves external actors in the making of products or services (Simon, 1962). Under this tradition, the notion of interfaces assumes extreme importance as it embeds some sort of coordination function which dictates how modules interact with each other and with the overall system (Baldwin & Clark, 2000; Simon, 1962).

Both literature streams similarly stress the importance of external actors for the development of platform organisations. Meanwhile, the economics perspective puts the accent on resources and transactions; the engineering perspective insists on mix-and-match or recombinant innovation and dynamic capabilities. The strong influence of these two perspectives the "transaction-oriented" and the "innovation-oriented" (Gawer, 2014) has narrowed the focus of subsequent studies to certain categories of resources and external actors out of which has emerged a broader class of innovators –commonly understood as complementors and often identified with developers. So far, the literature

has not considered a broader notion of power and control related for instance to conflicts (i.e. offensive boundary-spanning activities like acquisitions or other *nonownership* mechanisms) or more general normative drivers of boundary-making triggered by social rules, roles and beliefs. Likewise, the State or other important external actors which are often mentioned in the organisation studies and management literature are absent (see i.e. Mazzucato, 2015). Perhaps more importantly, there has been no much debate around the role of technology in conditioning any of these drivers or in adding new dimensions related to control and governance in organisations that operate predominantly in digital settings.

The concept of platform boundaries inherits much of its characteristics and breadth from these perspectives. A great deal of literature around boundaries in digital platforms and platform ecosystems in fact only focuses on the relationship between a platform and third-party developers or complementors (e.g. Boudreau, 2010, 2012; Ghazawneh and Henfridsson, 2015; Ondrus et al., 2015; Parker & Van Alstyne, 2018; Wareham et al. 2014). The engineering perspective's attention to interfaces as coordination mechanisms has framed the notion of boundaries resources predominantly as specific kind of technologies such as Application Programming Interfaces (APIs) and Software Development Kits (SDKs) which are used to govern the relationship between platform owners and third-party complementors. "Boundary resources are the software tools and regulations that serve as the interface for the arm's-length relationship between the platform owner and the application developer" (Ghazawneh & Henfridsson, 2013, p. 174). As Eaton et al. further specify "it is through boundary resources that the focal firm attempt to establish the boundary of the service systems, specifying what is allowed and what is not" (Eaton et al., 2015, p. 220). Boundary-making and boundary resources are central issues also for platform ecosystems. Jacobides, Cennamo and Gawer (2018, p.

2264) define ecosystems as "the set of actors with varying degrees of multilateral, non-generic complementarities that are not fully hierarchically controlled". Complementarities among actor activities within the ecosystem are key to define the ecosystem's structure and configuration as well as to trace its changes and evolution. Therefore boundary-making in platform ecosystems becomes the orchestration of multilateral dependence through certain rules and roles structures which are different from traditional networks or supply-chain relations (see also Adner, 2017). So far it seems that the literature on ecosystem develops mostly in continuity with the central tenets of the engineering perspective –namely modularity and interfaces as coordination mechanisms, together with its emphasis on the complementary-based approach to innovation or to value creation.

Albeit important, we believe that the focus on developers or complementors gives a rather partial view of the variety of actors involved in platform ecosystems and may constrain the conceptualisation of boundary resources by excluding a richer set of modalities and related mechanisms with which focal platform establish and govern their relationship with their external environment (Cusumano, 2019; Gorwa, 2019; Skog et al., 2018). As we mentioned, the dominant economic-efficiency approach and the innovation-capabilities approach have also limited the study on drivers of boundary-making activities in platforms and platform ecosystems leaving out the normative dimension and related mechanisms of power (Aldrich, 1979; Etzioni, 1961; Santos & Eisenhardt, 2005). Expanding the conceptual toolkit on boundary-making, we argue, opens up our understanding of governance mechanisms in platform ecosystems and may shed light on little known dynamics of value creation and value capture which extend beyond the platform-developers dyad.

Research design and methodology

Boundary-making is intrinsically connected with how organisations exercise control over their environment. In this respect, our study investigates the use of boundary resources in boundary-making activities which we define as all the technologies through which platform organisations coordinate and control their relation and exchange of resources with heterogeneous actors. Our broader research strategy is to use empirical evidence as the basis for advancing analytic generalisations (Yin, 2009) on the links between boundary-making, boundary resources and the evolution of platform ecosystem configuration. To do so, we adopt a qualitative design and a longitudinal approach to the case study of TripAdvisor (from its foundation in 2000 to March 2019) (see also Alaimo et al., 2020 [Paper One]). The object of our analysis is to understand the modalities by which TripAdvisor establishes relations with external actors and how such modalities drive ecosystem's evolution.

Data have been collected mainly from TripAdvisor media centre[18]. The online publicly available archive comprises press releases published by TripAdvisor since its early years. These 3,944 records provide first-hand factual information about events in the history of the platform from 2000 until March 2019, the end date of our data collection. We complemented this source of empirical evidence with TripAdvisor's annual reports (10-K form) since 2011 when TripAdvisor became an independent company. In addition, we used two secondary interviews of Stephen Kaufer, TripAdvisor CEO over the years[19].

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[18] https://tripadvisor.mediaroom.com

[19] The first interview is published in the book "Founders at Work: Stories of Startups' Early Days" (Livingston, 2007). The second interview is on the online book titled "The Definitive Oral History of Online Travel" (Schaal 2016).

The interviews provided us with evidence from early events of TripAdvisor history which is hard to find otherwise.

Our analysis began by classifying the press releases according to their content. Three categories emerged: rollouts, partnerships and acquisitions, awards and reports. The 116 publications classified as partnerships and acquisitions together with the eight TripAdvisor's annual reports have served to identify the actors with whom TripAdvisor has forged relationships over time. The 220 publications classified as rollouts has played a crucial role in tracing the evolution of platform features and infer the relationships between actors and their roles. We first identified actors in the acquisition and partnerships publications and 10-K annual reports over time. Out of the 217 actors we identified, some were groups or categories of actors defined by TripAdvisor (i.e. hotel subscribers). Building on this, we further categorised all the remaining actors of the TripAdvisor ecosystem by undertaking several iterative cycles of readings and analysis between the partnership and acquisition publications, the 10-K reports and external documents. We identified and classified all the actors in 16 categories (e.g. booking platforms, online travel agencies, ads brokers, etc.). In the second stage of analysis, we systematically analysed in iterative cycles of coding and pattern codes (Miles et al., 2014) the roll-outs sub-category, the 10-K annual reports and well-known online publishers (e.g. Skift, TechCrunch) to refine our actor categories and to classify their relations with TripAdvisor.

This analysis lacked the adequate contextual background to understand the evolution of TripAdvisor's relationships and the reconfiguration of its ecosystem. To this end, we used an alluvial time-series diagram (see Figure 14) to visualise the transformation in terms of actors and relationships (Miles et al., 2014; Yin, 2009). The alluvial diagram linked years,

type of relationships, and type of actors from the previous analysis. Through this analysis, we were also able to document the technologies used as boundary resources and to identify the influence of technical features on four main relationship types which we classified as i. partnerships, ii. acquisitions, iii. commercial agreements and iv. "plug-and-play" models. We use the term "plug-and-play" in its broader conception to signify the temporary and informal nature of the relation established which is almost completely governed by the technology used. By looking at the different mechanisms and technologies through which TripAdvisor has established and governed all the different set of relations across all of the categories of external actors in the ecosystem along its twenty years of activity, we lay the ground for subsequently explaining and discussing the role of boundary-making mechanisms in the evolution of platform ecosystems.

Empirical Narrative: the evolution of TripAdvisor's ecosystem

Founded in February 2000 as a search engine for travellers, TripAdvisor has grown to become the biggest social media platform in the online travel sector with a vast number of reviews and opinions about diverse travel business globally. In addition, TripAdvisor owns and operates a portfolio of websites and businesses, which includes a big travel media group which alone controls 27 travel brands[20] in 49 markets (TripAdvisor, 2019). One of the critical factors of TripAdvisor's success has been the steady growth of the platform's user base. In 2006, TripAdvisor had just six million user-generated reviews and opinions around travel accommodation and destinations which reached 795 million by the middle of 2019 with 490 million average monthly unique visitors (ibid). Key to TripAdvisor growth has been the formation and development of a rich ecosystem of actors

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[20] http://ir.tripadvisor.com/static-files/53391638-b324-4f37-b24b-b0a75f58d2a2

which have differently participated in TripAdvisor's core activity, the provision of data-based services for the travel and hospitality industry.

When TripAdvisor was founded in 2000, the Web was populated by rich travel content sites, yet travel information was fragmented and hard to find. Having seen the opportunity of providing a search service in the online travel industry, TripAdvisor built a database with up-to-date travel content by indexing relevant online travel hubs (Livingston, 2007, p. 364). In this way, TripAdvisor end-users were able to see and access up-to-date travel content from several online travel hubs in one place, TripAdvisor website (Livingston, 2007, p. 364). To do this, TripAdvisor relied on two technologies: crawling and syndication technologies as well as manual tasks. First, TripAdvisor used crawling technologies to automatically copy and record the content links to TripAdvisor database. These content links were manually classified by TripAdvisor employees. After this classification, content links were able to be displayed on TripAdvisor websites by using web syndication technology. This technology linked the content back to its sources redirecting users to different travel hub sites. Thanks to the semi-automated onboarding of data and content and the creation of a rich database of links to hotels and destinations, TripAdvisor started to grow both its end-user side (travellers) and content publisher side (companies).

In late 2001 as TripAdvisor website saw a traffic increase due to positive response of end-users, TripAdvisor was able to create several commercial agreements based on its own proprietary contextual link advertising technology (Livingston, 2007). Contextual link advertising refers to the display of highly targeted ads selected automatically on the basis of search queries. Contextual link performed substantially better than traditional ads display (typically varied between 4% and 12% in contrast to 0.25% of traditional ads).

The **commercial agreements** were regulated by the Cost-per-Click (CPC) price scheme model which means that advertisers, such as Online Travel Agencies (OTAs) or travel sites, paid TripAdvisor only when the link displayed was clicked (click-through) by a user instead of paying upfront for ads displaying (as in traditional models). The number of click-throughs and its price were established ex-ante by internal agreement between TripAdvisor and its clients (Livingston, 2007). Specific tracking and monitoring technologies applied to the link displayed performed a crucial task of automated monitoring, counting and checking performance from both parties involved in the transaction (Livingston, 2007; TripAdvisor, 2002). The main **clients for CPC** ads were Online Travel Agencies (OTAs) such as Expedia. In 2002, TripAdvisor began what it called partnerships (TripAdvisor, 2002) with advertising agencies such as Avenue A or Mullen, seeking to expand its CPC ads client portfolio. These travel agencies acted as **ads brokers** by connecting different merchants or vendors to TripAdvisor and coordinating the display of ads.

Ads brokers used a family of technologies that enabled the storing, distribution, delivery and analysis of ads on behalf of clients (merchants). Over the years, **ads brokers** have clustered into "ads networks", alliances of different ads brokers that used automated and centralised content and data hubs to distribute ads and track user response across multiple websites. Travel agencies benefited by the partnership with TripAdvisor as they were able to offer to their clients a product that had a significant conversion rate. Contextual links advertising continued to work until 2013 when the price comparison substituted it.

Since 2004, TripAdvisor started to implement and govern end-user participation on the platform as a means for generating content and data. End-users could gradually chat in forums and rate and review hotels and destinations. The production of content and data

from the platform participation of end-users was a keystone for the development of a number of relations between TripAdvisor and external actors and it marked a set of changes in TripAdvisor's activities and operations including the substantial decrease of content links that disappeared completely by 2011 (as end-users became the main content-generators). The increased presence of end-users on the platform marked the possibility of expanding advertising commercial agreements and partnerships. In 2006, for instance, TripAdvisor started to use web banners by signing a partnership with an advertising agency called Travel Ad Network (TAN). Web banners work by embedding graphic ads –which may also contain an active link to a merchant or vendor's webpage. The web banner's content, the ad, is dynamically delivered and controlled by the **ads broker**. The main technology governing web banner placement is RSS (Really Simple Syndication), a technology that allows third parties to embed, update and control the content in a portion of a webpage (ad space). An agreement between the parties defined the ads' position but industry standards regulated their size (TripAdvisor, 2006).

As user-generated content became a valuable asset for the platform, a different set of relationships was developed to distribute the content produced on TripAdvisor to third-party websites. Before 2006 TripAdvisor's content was only available on the platform, from that year onward TripAdvisor developed several tools based on web technologies such as RSS, widgets and APIs to distribute content across various websites. Before embedding TripAdvisor's licensed content on their sites, third-party websites had to become a partner by subscribing TripAdvisor's terms and conditions (TripAdvisor, 2019a). These technologies in turn allowed TripAdvisor to expand its audience as well as to increase its web traffic, as the content displayed on third-party websites led back to TripAdvisor. **Content distribution partners** benefited by having up to date content in their sites (e.g. the latest reviews, ratings and awards) (TripAdvisor, 2011a). The main

content distribution partners were travel publishers, travel platforms and digital platforms such as EUROSTAR, thetrainline.com or Yahoo. By 2011, TripAdvisor counted more than 250 agreements with third-party companies for content distribution which guaranteed to TripAdvisor a presence on more than 30,000 websites (TripAdvisor, 2011b). In 2015 the agreements reached 1,300 content distribution partners (TripAdvisor FR, 2015). Technological advances have enabled TripAdvisor to develop more sophisticated tools to distribute its content. As of 2019, the platform used up to ten widgets and sixteen requests via API (TripAdvisor 2019a; 2019b).

Since 2007, content distribution tools such as widgets and RSS (excluding APIs), have been available for small hotels under a **subscription-based model**. These tools and subscription models gave small hotels the possibility, for the first time, to become publishers and curators of TripAdvisor content on their own websites. They have been able, for instance, to display reviews or rating widgets (TripAdvisor, 2007). Additional features for small hotels subscribers arrived at the beginning of 2010 with *Business Listings* **subscription**. This subscription enabled owners to add or update content to their TripAdvisor's profile. For example, owners were able to add a link to their websites or select three reviews to be shown upfront. Also, they could promote "special offers" that increased their visibility on the platform.

Additionally, with the implementation of TripAdvisor's *Review Express tool*, subscribers had the opportunity to gather feedback and reviews from travellers through customisable emails. Review Express tool was part of the service offered by the TripAdvisor's owner centre, a dashboard that gave hotel owners the possibility of managing their visibility on TripAdvisor and curating their relations with TripAdvisor's end-users. The reviews collected via email with the Review Express tool were also displayed on TripAdvisor,

making subscribers using this service **TripAdvisor content providers** (in addition to content distributors). In 2012, Review Express began to be available to digital platforms and hotels groups (TripAdvisor, 2012).

As mentioned, the presence and activities of end-users (travellers) on TripAdvisor has been one of the most important drivers of growth for the platform. Since 2006, TripAdvisor developed social media features and expanded on platform's functionalities dedicated to structuring the activities of end-users (i.e. ratings, reviewing, opinions, comments, etc.). This set of user platform activities, in turn, boasted both user data and content production. In 2008, TripAdvisor started to connect with other social media platforms through the development of apps (e.g. it developed Cities I've Visited, Traveller IQ Challenge and Local Picks on Facebook and MySpace). These apps were ruled by a software development kit (SDK) that each host platform provided. SDKs are packages of tools such as compiler, debugger or software frameworks that make easy to create apps that run on social media platforms. The apps were able to access users' public profile information available on the host platform, including users' friend lists, interests, photos and albums, video, as well as status and mood (TripAdvisor, 2008). In a way, these developments signalled the beginning of the social web, where social media platforms started to be connected through apps and exchanged both data and content. In so doing, a number of social media platforms became **data provider partners**. The partnership with Facebook was strengthened further in 2010 when TripAdvisor adopted Facebook login and social graph APIs. These kinds of relationships did not have a contractual agreement but were enabled by technologies such as APIs and SDKs. This, the so-called plug-and-play model, was adopted also for the integration of TripAdvisor with Google maps, a leader web mapping service. Since 2016, TripAdvisor relied on similar kinds of

integrations or plug-and-play models with third-party booking engines for booking tours and attractions such as FareHarbor, Peek, and Bokun.

In 2009, TripAdvisor began a new set of partnerships with several online businesses. Differently from previous examples, all of these partnerships went toward complementing or leveraging TripAdvisor **IT capabilities** and service provisions. For instance, in partnership with Market Metrix, TripAdvisor added data analytics capabilities to the dashboard in the (hotel) owner centre. Subscribers could create a reporting page and measure guest's satisfaction. As of this date, Market Metrix and TripAdvisor have introduced a number of solutions that help hotels to use guest reviews to improve business performance. More recently, TripAdvisor established a partnership with ReviewPush (2017) and MomentFeed (2018), both have data analytics capabilities by which TripAdvisor leverage its offers to restaurant owners' subscribers.

In 2009, TripAdvisor began to **extend its services** by making partnerships with digital platforms that provided services in adjacent domains. Many of these partnerships are still active. However, some of these relationships have changed due to TripAdvisor acquired the digital platform. This is the case of TheFork and Viator were acquired in 2014. These digital platforms were the pillar of restaurant and attractions services offered by TripAdvisor. Thanks to the partnership with OpenTable, Toptable and TheFork – leading providers of online restaurant reservations – TripAdvisor's end-users were able to find and book restaurants. Thus, in a few clicks, end-users were able to reserve a table directly in one of these two platforms. Following the same logic, TripAdvisor in 2014 did a partnership with Viator, making it possible to book tours. At the end of 2014, TripAdvisor acquired Viator as well.

Along the same lines, TripAdvisor was also one of the first to integrate Uber functionality into its platform by using Uber's API. When users searched for restaurants, attractions or hotels, they could see an estimate of Uber car fares and the waiting times for pickup. The "Ride there with Uber" button redirected users to Uber to complete the reservation and sent a car to their location. In 2013, by using Locu API, TripAdvisor made available restaurant menus. Locu was a **content provider** which crawled content from websites and made available through its API. In 2016, TripAdvisor established a partnership with EatWith to provide a "Dine with a Local Chef" service. In 2017, teaming up with Deliveroo, TripAdvisor enabled its users to access Deliveroo's restaurant network. The scheme connected more than 20,000 restaurants across 12 countries throughout Europe, the Middle East and the Asia Pacific regions. Restaurants listed in both TripAdvisor and Deliveroo have displayed an "Order Online" button which redirects users to the specific restaurant on the Deliveroo platform to complete their orders.

The implementation of the *Price comparison* functionality on TripAdvisor platform in July 2013 brought about a new class of actors and reconfigured a number of relations within the TripAdvisor ecosystem. Price Comparison, which is still one of the main searching functionalities of the platform today, is a metasearch auction which allows hotel owners and OTAs to bid for placing their booking links in the top position of the list of hotels displayed as the results of the price comparison section. This feature introduced a change in the governance of contextual links, previously mainly set by contract. With Price comparison, prices and traffics are determined by a dynamic, competitive algorithmic bidding process. The adoption of this online feature – unique in the hospitality sector – made it possible for small hotels owners to access advertising services which were previously limited to major OTAs and hotel group chains. Small hotels can access to the bidding by **subscribing** to both TripAdvisor and TripAdvisor connectivity partner.

TripAdvisor connectivity partners are Internet Booking Engines (IBE), software platforms that make hotels' rooms bookable online. IBEs provide the infrastructure to connect a hotel reservation system (where a hotel reservation system does not exist they provide one) with online distribution channels, including web, mobile, OTAs and others. This means that the same hotel rooms become available online either B2C (i.e. via hotel websites) or B2B (i.e. via Booking.com) and their status is automatically updated in case a new booking happens. Though IBEs are not visible on TripAdvisor's site, they play a key role as **hotel room data providers**. The exchange of data between IBEs and B2B channels does not occur automatically. There has to be an agreement in place between the parties to make data transference via the channel's API. The adoption and usage of TripConnect API are not exactly frictionless. In fact, IBEs, OTAs or hotel groups which are willing to use TripAdvisor TripConnect API must develop, test and certificate a piece of software by which data between the parties are transferred.

In 2014, TripAdvisor developed Instant booking (rolled out globally in 2016). This feature, which is still active on TripAdvisor, lets end-users complete their hotel booking on the platform. It represents an alternative to the booking functionality offered by booking partner sites like OTAs and big hotel chains as it allows end-users to complete the transaction without leaving TripAdvisor. Booking is made possible by the adoption and implementation of secure payment infrastructure and by the development of a new API called Instant Booking. This API enables the exchange of data about room and booking in real-time. Similarly to the procedure of TripConnect API, the use of Instant Booking API requires a certification process. By this process, IBEs, OTAs and hotels groups become **connectivity partners** and are able to use the API. Importantly, small hotels can take part in instant booking only if they have an **instant booking subscription** and their IBE is an instant booking connectivity partner. This subscription establishes a

pay-per-booking commission model adopting the same model than OTAs use for their own clients. With the implementation of this service, TripAdvisor and OTAs became co-opetitors[21] as they still cooperate for other services but compete for the offering of booking to hoteliers.

During 2006 to 2016, TripAdvisor acquired 41 companies; they complemented or leveraged TripAdvisor's services or its IT capabilities. Among them, there were metasearch platforms, booking platforms, apps and data analytics companies. We have classified the acquisitions in three types: IT capabilities, content, and business networks. Before TripAdvisor developed its own price comparison and instant booking, the majority of the acquisitions were linked to the implementation of online booking capabilities. These platforms facilitated the exchange of information about room availability, prices and others (e.g. photos, reviews, facilities, deals etc.). They allowed users to compare information and to book. Online booking features required a secure IT infrastructure to protect users' privacy and financial information (e.g. online payment). Among this group, the acquisition of Bookingbuddy.com in 2007 is probably the most important as it gave TripAdvisor an entry into booking technology. Booking Buddy had a travel search tool that helped users find inexpensive flights, hotels, car rentals, and cruises. Booking Buddy also offered a free listing of the latest travel deals and special offers from high-value travel suppliers. After Booking Buddy, ten different booking platforms have been acquired (until 2014). The same year, as mentioned, TripAdvisor acquired its then partners TheFork and Viator, leading booking platforms for restaurants and tours respectively.

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[21] Term used to denote that two actors engage in a dual relationship. They cooperate while compete

Not related to booking but to the enhancement of other **IT capabilities** and associated services, in more recent years TripAdvisor acquired, for instance, Citymaps, a social mapping platform that allowed tourists to discover points of interest and hidden places throughout the world. The website and the application made it easier for users to find places to visit, navigate through urban destinations and share their favourite sites with their friends. In 2018 TripAdvisor acquired Bokun, a leading provider of business management technology for the attraction industry. With this acquisition, TripAdvisor provided suppliers with technical solutions in addition to its role as the sector's largest distribution channel. Bokun had a business management software created specifically for tours, attractions and experiences vendors. It acted as an IBE, providing inventory channel manager but also a price management tool. With this service implementation, TripAdvisor's attraction subscribers were able to handle booking, inventory management and dynamic pricing based on analytics. As per the category of content-related acquisitions, from 2006 to 2013, TripAdvisor acquired ten travel media communities. They were all websites on which users could leave comments about products or services. These communities all shared Web 2.0 technologies which allow users to share content and procure data and were all usually monetised by advertising. From this date (2019), four of these platforms are not available. Business network acquisition began after 2014 when TripAdvisor acquired TheFork which controlled a network of restaurants based in Europe. To expand the numbers of bookable restaurants and geographic areas, TripAdvisor further acquired seven restaurant booking platforms covering Oceania and Latin America.

Alluvial graph: TripAdvisor's Ecosystem reconfiguration

The alluvial diagram below shows the relationships that TripAdvisor has forged with external actors over time (Figure 14). The diagram has four columns that shown: the years, the type of relationship, the categories of actors, and the names of the external actors from left to right. Each colour coding represents a type of relationship that TripAdvisor has established with 16 different categories of actors. In this way, it can be visualized the different changes in relationships related to actors and years.

Instead of being static, the alluvial diagram shows a dynamic view of both the ecosystem of actors and TripAdvisor's relationships. With few exceptions, TripAdvisor has forged at least two different relationships with each category of actors have. In addition, this fluidity can be observed by comparing the relationships established in two consecutive years. Actually, none of the years presents the same type of relationships; due to this, it is difficult to visualize a precise cut. However, we distinguished four configurations taking into account the arrived of new actors.

TripAdvisor before 2009 established relationships mainly driven by two objectives: enrich the content that offered to its end-users and enrich its portfolio of clients. In this first period, TripAdvisor forged relationships with Travel published via crawler technology without any contractual agreement obtain an extract of their content to then redirect to end-users to their websites via web syndication technology (Plug and play). Other significant actors in this period were OTA, booking platforms and Advertising agencies who related to TripAdvisor under Cost per Click model. This model established a contractual agreement between the parties in which the number of clicks and its price was stipulated with each client. This model was implemented by contextual advertising technology.

The second configuration, we set in 2010 by the entrance of a new actor and a new relationship. Small hotels began to relate with TripAdvisor through a subscription that allowed them to access to technology to collect reviews (content provider) and display its ranking or reviews in their own websites (content distributor). In addition, small hotels were able to see its performance in TripAdvisor owner site thank a partnership between TripAdvisor and a data analytic company. This period marked the beginning of TripAdvisor services extension as signalled the boost of partnership with several digital platforms to provided complimentary services. Also, content distribution partnerships significant increase and travel publisher engage in a double relationship by adding the relationship of content distributors to the content provider and plug and play.

In 2013 we set the starting the third period which matched with the replacement on Cost per click advertising to bidding advertising. Though there were not many new actors, many relationships changed. Small hotels for the first time could directly advertise their rooms by a bidding subscription. To do this, small hotels first required to have a subscription with TripAdvisor and an IBE who in turn had to be TripAdvisor partnership. This partnership was established by TripAdvisor's API that requested to the IBE real-time rooms' prices and availability. The bidding Advertising significantly changed the relationship between TripAdvisor and OTA as they became partners instead of Cost per Click clients. From a contractual agreement moved to real-time bidding.

Another transformation in the configuration of relationships and actors can be observed in 2015. This transformation coincided with the rollout of instant booking, which coexisted with the bidding advertising. In this way, small hotels, OTA and IBEs added a new modality to relate with TripAdvisor. Small hotels became clients by subscribing in a commission model. TripAdvisor developed a new API to implement the booking, so IBEs

needed to certificate to connect the new API. By this instant booking partnerships, OTA

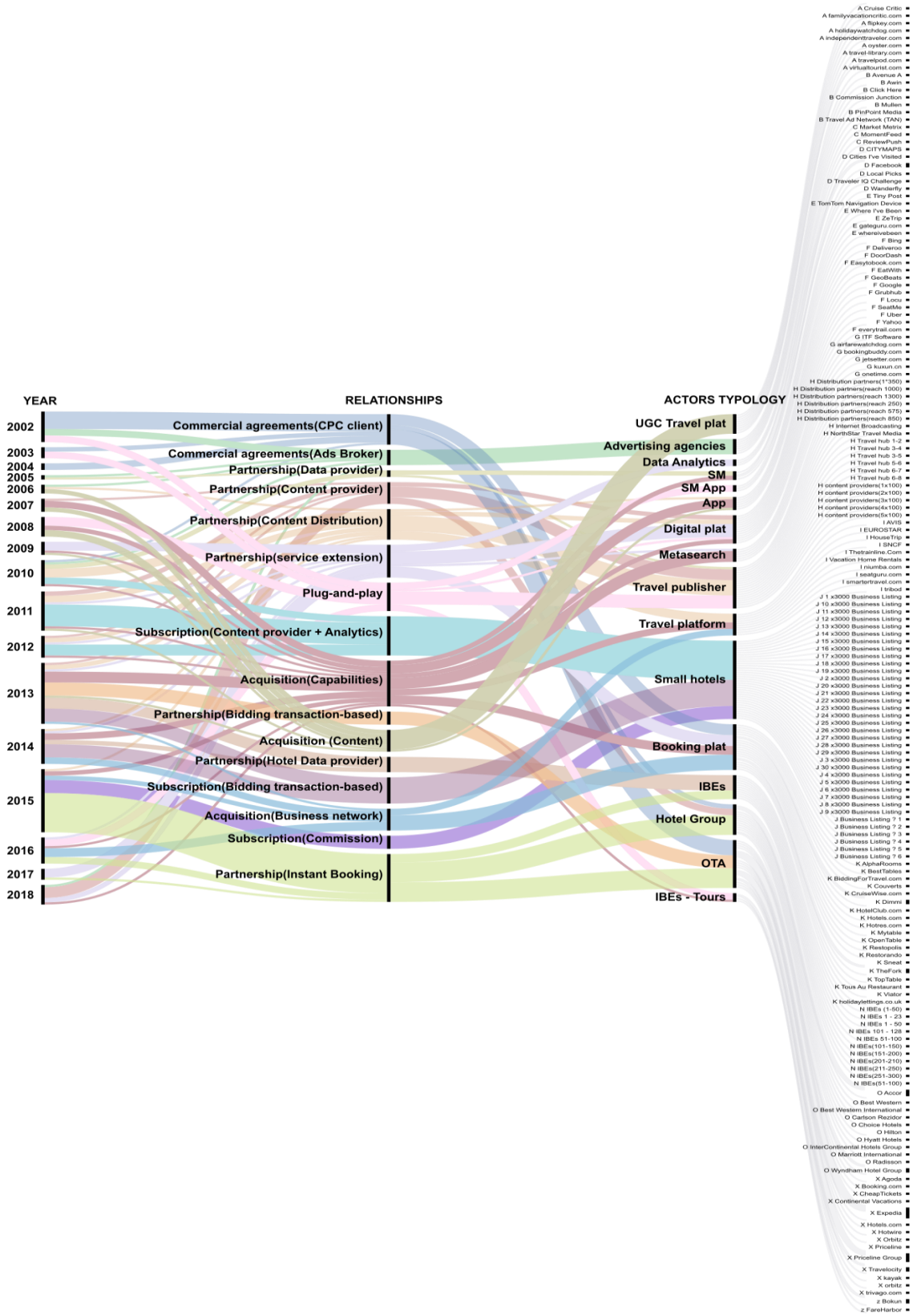became co-opetitors with TripAdvisor as both offered booking options to hoteliers.

Figure 14. Evolution of TripAdvisor's relationships and actors (2000 to 2019).

Discussion

During the twenty years of its evolution, TripAdvisor has grown to become a vital player of the digital travel and hospitality industry. Its leadership position can be accounted for by our narrative which outlines the story of the many mechanisms (i.e. partnerships, acquisitions, commercial agreements, plug-and-play solutions) with which TripAdvisor has been able to establish, govern and grow its now rich ecosystem. TripAdvisor has been able to thrive on the exchange of resources with its external environment yet maintaining its degree of autonomy. The platform has engaged in a number of boundary-spanning and boundary-maintaining strategies, such as for instance the decision of acquiring its longstanding partners TheFork and Viator in 2014, which have been crucial for the evolution of its ecosystem configuration. Our narrative documents a complex and changing configuration of relations which are shaped by boundary-making work. Figure 1 gives an overview of the evolution of relationships between TripAdvisor and external actors. The alluvial diagram highlights the temporal dimension of boundary-making work connecting the type of relations with actor categories and names.

The portrait that emerges from such a rich picture is qualitatively different from existing accounts of platform boundaries and existing studies on boundary resources. First, our narrative encompasses all the actors that have engaged with TripAdvisor such as for instance ads brokers, data providers, content providers, OTAs, IBEs, hotels, end-users, booking platforms, among others. (see Figure 1 second and fourth columns which report actor categories and names respectively). Second, it considers all the technologies that are used to govern and control the exchange of resources across the whole ecosystem and along the twenty years of TripAdvisor history. These are by no means limited to APIs and SDKs and platform interfaces such as dashboards and user interfaces, but include crawlers and trackers, RSS and web syndication technologies and a number of web

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objects such as banners, plugins and social buttons. By implementing these technologies, TripAdvisor has effectively shaped the evolution of its ecosystem. Specifically, TripAdvisor's boundary-making, the modality of relationship and the development of technologies, has established and coordinated non-generic complementarities (i.e. strategic partnerships for the provision of data analytic service and real-time bidding functionalities), engaged in competition with its traditional clients and partners (OTAs became co-opetitors with the implementation of booking service), created new markets out of its data capabilities (contextual links) and ultimately gained a position of power over hotel chains and hoteliers (governed by a subscription service provision). APIs and SDKs as boundary resources are central but alone they cannot account for long-term platform ecosystem strategy and for the evolution of its mechanisms of value creation and value capture over time.

Table 10 illustrates the key drivers and mechanisms of boundary-making on TripAdvisor. Drawing from the literature reviewed, we use three main drivers of boundary-making which we call i. economics, ii. innovation and iii. power-based. The economics-based drivers are linked to boundaries of efficiency (Santos & Eisenhardt, 2005) and are structured under utilitarian principles (Aldrich, 1979; Etzioni, 1961). They concern, for instance, the classic transaction model in economics, "make-or-buy" decisions, minimising governance costs. All the strategies used by TripAdvisor to extend and maintain its market fall into this category (i.e. ads brokerage, market extension partnership and plug-and-play decision, etc.). The second category of boundary-making drivers, what we call innovation-based, overlaps with boundaries of competence (Santos & Eisenhardt, 2005). They concern the central themes of innovation and ecosystem

literature such as the fostering of dynamic capabilities, the making of non-generic complementarities and mix-and-match innovation (Adner, 2017; Jacobides et al., 2018).

Table 10. Drivers and mechanisms of boundary-making on TripAdvisor (2000-2019)

Drivers / Mechanisms	Economics	Innovation	Power
Partnerships	TAN and Ads Brokers (Banners) Market extension partnerships (The Fork, Viator etc.)	Apps development and Data provider partners (social media APIs, SDKs based) Data Analytics Partnership (i.e. Market Metrix)	Content Distribution Partners (1,300 partners in 2015) Content provider partners (Review Collection Platforms)
Acquisitions	TheFork and Viator (2014) Travel media communities (four dismissed) Business network extension (i.e. Mytable, Dimmi)	IT capabilities and functionalities (online booking features i.e. BookingBuddy, Citymaps) IT and service capabilities (i.e. Bokun platform and software)	Travel media communities (ten between 2006-2016)
Commercial agreements (client, subscription, bidding-based model and commission-based models)	CPC Clients (OTAs and Travel sites) Ads Brokers (CPC)	TripConnect API, real-time dynamic auction on price comparison, TripAdvisor Connectivity Partners (IBEs), small Hotels and OTAs (subscription and APIs based)	Business Listing Subscription (small hotels) InstantBooking API, pay-per-booking commission model for hoteliers (in competition with OTAs)
Plug-and-play models	APIs for market extension (i.e. Uber, Deliveroo)	APIs and SDKs for app development (Facebook and MySpace) APIs for service extension (i.e. Google Maps)	Web crawlers Web syndication

We consider this category as falling in between utilitarian and normative principles (Aldrich, 1979; Etzioni, 1961). All the strategies used by TripAdvisor to extend and maintain its IT and digital service capabilities fall into this category (i.e. apps development and data provider partnerships, IT capabilities acquisitions, API for digital service extension, etc.). The third category, which we label as power-based drivers, covers boundaries of power and of identities (Santos & Eisenhardt, 2005) and is structured under coercive as well as normative principles (Aldrich, 1979; Etzioni, 1961). Legitimacy,

identity and power but also the offensive use of boundary are all strategies which are visible within this category. If we look at the example of TripAdvisor boundary-making mechanisms within this category we can see that they are characterised for their massive numbers (see for instance the quota of 1,300 content distribution partners reached in 2015), asymmetries in power relation (i.e. hotelier subscription of service), and the use of automated methods (crawlers and trackers) to gather external resources such as data and content. The offensive use of boundaries is illustrated by the massive acquisition of travel media communities. Out of the ten acquired in ten years, four were dismissed.

Beyond its rich account of boundary-making in platform ecosystems, by making visible the coupling between mechanisms and drivers of boundary-making, our framework points to the fact that technology has a much more significant role in shaping boundary-making strategy and in accelerating change in the configuration of the ecosystem. The existing literature of boundary resources, in general, confronts the issue of how technology changes organisational relations with their environment only by framing boundary resources as tools for the boundary of efficiency and boundary of competence (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013, 2015). Drawing from a richer theoretical account on the drivers of boundary-making –like the unfolding of organisational relations with their environment (Aldrich, 1979; Santos & Eisenhardt, 2005), we suggest that the role of technology in platform ecosystems is not limited to the adoption and use of boundary resources, but it effectively intervenes as a driver of boundary-making. For digital platforms, technology is not just a tool but an external resource to be controlled, co-opted and governed as it often complements existing IT capabilities or data sources, shapes market efficiency and influences legitimacy. Digital platforms will make strategic choices on how to interact in their environment by considering how to gain existing technological resources in their environment. The

offensive use of boundaries which we can observe both in acquisitions and in *nonownership* mechanisms such as alliances and friendship ties with competitors is driven, in the case of TripAdvisor, mostly by what we call "technology-as-resources" (Santos & Eisenhardt, 2005, p. 496). "Technology-as-resource" attests to the role of technology as a driver in the strategy of boundary-making, in an environment replete with data and technologies, platform organisations form their ties and alliances on the basis of how such resources are distributed in the environment. "Technology-as-resource" substantially alters mechanisms of boundary making. Boundary-spanning for instance is driven by the need to acquire the latest technological developments. The offensive use of boundaries as seen is determined by the acquisition of technological capabilities, data and content.

There is another aspect of technology that emerges from the boundary-making of TripAdvisor. We call it "technology-as-governance" to signal the role of technology as a driver of a different logic of control (Kallinikos, 2011; Kallinikos et al., 2013; Lessig, 1998; Zuboff, 1988). "Technology-as-governance" substantially intervenes in shaping how platform organisations control their boundaries. It changes qualitatively how boundary-making can be implemented and orchestrated. Against drivers that may appear as the same to traditional organisations, completely different scenarios of enforcement and control are opened by the use of specific technologies. For instance, minimising transaction costs can now be achieved through automation, and in the case of TripAdvisor drives boundary-making through partnerships which, differently from before, are implemented and controlled via automated tracking and real-time monitoring of all the partners booking activities. As a result, partnerships have changed on TripAdvisor, going from mostly contractual-based rules to automated-based rules. Meanwhile, the partnership conditions were established ex-ante via contract up to 2013, after that,

conditions were simply monitored ex-post thanks to the implementation of specific technologies of booking and monitoring and the development of the infrastructures to exchange real-time data between IBEs, OTAs and TripAdvisor.

Technology does not only govern the exchange of resources in the platform ecosystem, but it is itself the essential resource exchanged (Alaimo et al. 2020 [Paper One]). Our study proposes to see the role of technology in shaping drivers of boundary making in what we call "technology-as-resource" and its role in shifting mechanisms of boundary-making as it offers a qualitatively different means of control as "technology-as-governance".

Conclusions

In this paper, we have investigated the mechanisms and drivers of boundary-making in platform ecosystems. Boundary-making is central in platform ecosystems as it concerns how a focal platform (or platform leader) interacts with its ecosystem's actors and how it benefits from external resources yet maintaining a degree of autonomy to operate (Aldrich, 1979). Boundary-making, we argued, reflects a fundamental strategic choice which has repercussions not just for the platform's own business model and opportunity to grow but also for the evolution of the entire ecosystem within which the platform is embedded (Gawer & Cusumano, 2014; Jacobides et al., 2018). We have undertaken a case study of TripAdvisor to illustrate and categorise all the mechanisms used by TripAdvisor to orchestrate the exchange of resources with the actors operating within its ecosystems along with the (almost) twenty years of its activity.

As our findings illustrated, technology has a much greater role in determining both drivers and mechanisms of boundary-making (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013; 2015). Drawing from a richer theoretical account of organisations and

environments and how they relate (Aldrich, 1979; Santos & Eisenhardt, 2005; 2009), we have been able to suggest that boundary-making is essentially an issue of control that, in digital platforms is driven and governed not only by different (digital) tools but by a different (digital) logic of control. To signal the shift, we call this double influence of technology on boundary-making as "technology-as-resource" and "technology-as-governance". Our findings complement existing literature by proposing a revised and expanded definition of boundary-making and boundary-resources on platform ecosystems.

Chapter 5

Recapitulation and Conclusion

This final chapter briefly discusses the findings of the three papers that comprise this thesis. It highlights the connections between these papers and the manner in which they address the research question of this thesis. Furthermore, the chapter offers a discussion of the chief contribution this thesis makes to the existing literature on social media platforms, digital platforms, platform evolution and ecosystems. This chapter closes with a discussion of the limitations of the research, directions for further research and concluding remarks.

Summary of the Research Findings.

The dissertation studies the way in which social media platforms have evolved and attained their current status in the digital economy. It uses the case study of TripAdvisor, an emblematic social media platform in the online travel sector. Chapters two to four explore, from different angles and without undermining the role of users, the evolution of TripAdvisor as an economic organisation. The papers in these chapters stand alone, in the sense that they pose their specific research questions, and rely on their own approach, sources of evidence, and analysis. Nonetheless, the three papers are connected; each of them having been inspired by gaps in the existing literature (Chapter 1: Background and positioning), and each critically analysing the role of technology and data in sustaining TripAdvisor's operations. In particular, how these operations relate to the platform's expansion and economic involvement. What follows is a summary of the key findings of the three papers.

Paper one: Platform as service ecosystems – lessons from social media

This paper (Chapter 2) reconstructs the features launched by TripAdvisor over a period of 19 years. It draws on press releases from the TripAdvisor media centre archive that documented new feature rolled out between 2000 to 2019. The study assumes that social media are data-driven platforms (Alaimo & Kallinikos, 2017) that provide services to diverse actors. It investigates the role of technology and data in the evolution of TripAdvisor's services and the emergence of its ecosystem. In particular, the paper addresses the following questions: *How do data generation, flow and commercialisation drive ecosystem formation and account for the functional contribution data make to the emergence of ecosystem relationships?* The paper investigates the mechanisms by which user data are brought to bear on business transaction data. To better grasp these mechanisms, the paper addresses the following set of questions: *How do outgoing links between different forms or types of data, shape platform evolution and the rise of platform ecosystems? What lessons can we draw from the study of TripAdvisor as regards the role of such diverse types of data and the links they occasion to play in ecosystem formation?* In this way, this paper meets the aim of this thesis by placing technology and data at the centre of the research.

This paper examines TripAdvisor's evolution and the services it made of intending to innovate and expand its operations over time. This study found that the practices to procure, generate and exploit data have been pivotal to sustain and materialise a large number of TripAdvisor's services during its evolution. This paper makes visible the complex and reciprocal links between data and services, technological functionalities and actor roles. The paper identified three stages in TripAdvisor's evolution: as a search engine, social media platform, and end-to-end services. Each stage roughly corresponds

to the deployment of a specific type of data and technological functionalities that underpin a specific configuration of actors (including users) and roles.

The last stage of TripAdvisor's evolution reveals the formation of a complex web of commercial relationships by which TripAdvisor sustains its operations. Given this centrality of TripAdvisor's ecosystem, this paper additionally explores the link between data practices and the emergence of TripAdvisor's ecosystem. The findings reveal that TripAdvisor's commercial relationships are primarily made possible through data. Data emerge as a vital carrier of value but also as the cognitive medium on the basis of which relationships between ecosystem participants are forged. The different type of data and the practices, technologies and systems needed to capture, produce, and trade data, as well as the data themselves, constitute a complex grid that lay the foundations for commercial relationships over time. At the same time, data and their underlying conditions considerably shape the type and structure of the relationships of ecosystem participants and circumscribe possible routes to take.

This paper gives a first insight in understanding the current position of social media platforms within the digital economy and their evolution. It supports the thesis by revealing that technological and organisational capability to exploit data systematically play an essential role in the platform' evolution. At the same time, the platform's changes have moulded social and economic relations and have framed the actions of actors within the ecosystem.

The dissertation aims to bring together the economic, technological and organisational complexity of social media platforms without undermining the role of users. To gain a granular view of the role of users and the user-platform interactions, the thesis analysed

the TripAdvisor's user interfaces (webpages) from its foundation. This analysis is the core of the second paper which follows.

Paper two: Patterns of digital transformation – a study of TripAdvisor

This paper (Chapter 3) approaches the study of social media platform evolution through the analysis of TripAdvisor's webpages from its launch in 2000 up to January 2019. This atypical data collection and analysis draws upon the idea that a platform's webpages provide a window into its operations. Certainly, webpages do not entirely reveal or reflect the operational links across a number of layers under the platform's surface. However, especially in social-oriented digital platforms, they are the interfaces where core end-user interactions occur, and a full range of services are offered. In this way, this thesis argues that TripAdvisor's webpages can give a faithful testimony of its operational evolution.

This paper introduces a new theoretical lens, one that shifts the perspective from a macroscopic conceptualisation of digital platforms as business organisations or as architectural configurations of technological components, to a granular one. This lens enables an investigation of the detailed fabric of the technologically-mediated operations that constitute digital platforms, including social media, which it is widely glossed over (Faulkner & Runde, 2019; Grover & Lyytinen, 2015; Orlikowski & Iacono, 2001).

This paper, in particular, studies the links between TripAdvisor's transformations and the underlying technologies and technological objects by which TripAdvisor has sustained its operations over the two decades of its existence. It addresses the following research questions: *How do digital platforms organise and instrument their operations through the development and use of digital objects? How do such digital objects confer platforms their distinct identity?* A key point of the thesis is to comprehend the role of technology in the evolution of platform operations. To do this, the paper addresses the following

question: *How are the design and use of digital objects linked to the technological dynamics and the evolution of the internet ecosystem?*

This study combines digital and qualitative methods to explore, in detail, the interactions between users and the platform that occur in the user interface. It is assumed that those interactions are good approximations of lower-level processes that sustain everyday operations. The analysis indicates four distinct stages in the ongoing transformation of TripAdvisor. Each one of these stages denotes a distinguishable configuration of technological objects and functionalities, data practices and everyday operations. These configurations reveal that TripAdvisor has progressively shifted from a relatively static display of online travel information to personalised and real-time technological objects. At the same time, these configurations shape the roles of the platform's actors, but the role of users is the one who has ongoing for more substantial changes.

The user interfaces in the last stage of TripAdvisor bear upon real-time interactions with users and other actors in the platform's ecosystem. These are, supported by intensive data operations that draw on a number of constantly updatable data sources across its ecosystem. These operations require TripAdvisor to develop technological and organisational capabilities to deal with the abundant flow of data and then use these data to pursue its business objectives. However, the current capabilities would not have been possible without the capabilities that the platform developed in previous stages of its evolution. For example, TripAdvisor required to develop first the capability to trace, storage and compute users' actions and preferences to then developed the capability to use such data to produce recommendations and then personalisation.

The findings also show that, at each stage of TripAdvisor's evolution, its user webpages interfaces allowed new stylised forms of user participation while capturing and rendering

users preferences and activities into data under business objectives (Alaimo & Kallinikos, 2017; Gerlitz & Helmond, 2013; Shah, 2019; van Dijck, 2013). These changes, in turn, have added new roles that users can enact. The role of users has diversified from being only consumers of content to becoming, through their clicks, both a product to trade (via the exploitation of user data) and a customer (via booking). What is more, the significant quantity of user-generated content and the growing number of active users, triggered a change in TripAdvisor's user interfaces and the underlying operations. Users thus are not mere recipients they take part in the making of the platform by engaging or not in the use of TripAdvisor's technological objects (Faulkner & Runde, 2019). In so doing, the study suggests that the platform's operational identity is the result of an intricate interplay of technology, actors and strategies that influence and often reinforce one another.

Paper One (Chapter 2) focuses on understanding the evolution of TripAdvisor's services and the emergence of its ecosystem. It found out that the systematic exploitation of data has been pivotal to support and materialise a vast number of TripAdvisor's services during its evolution. As mentioned, in social-oriented digital platforms, webpages are the interfaces where core end-user interactions occur, and a full range of services are offered. In this way, this paper complements paper One by providing a granular view of the technological fabric that sustain the end-use webpages interfaces and the services offered on them.

Similar to paper One, this paper shed a light on the complex web of commercial relationships in which digital platforms are currently embedded. However, none of them explores in deep the evolution of the relationships that constitute the platform's ecosystem. The study of such evolution and the role of technology on it is the central focus of the paper Three.

Paper three: Boundary-making in platform ecosystems – the case of TripAdvisor

This paper (Chapter 4) retraces the commercial relationships that TripAdvisor has established over time and the configuration of the ecosystem. It primarily draws on press releases in the TripAdvisor media archive that document partnerships and acquisitions between 2000 to 2019, which was complemented with the analysis of rollout (Chapter 2). In particular, this paper approached the thesis's research question by investigating the mechanisms and drivers of boundary-making in platform ecosystems.

Boundary-making concerns how a platform interacts with its ecosystem's actors and how it benefits from external resources while maintaining its autonomy (Aldrich, 1979; Santos & Eisenhardt, 2005; Scott, 2008; Thompson, 1967). The current literature on platform boundaries and boundary resources focuses predominantly on the relationships between the platform and third-party developers or complementors (e.g. Boudreau, 2010, 2012; Eaton et al. 2015; Ghazawneh & Henfridsson, 2013; Parker & Van Alstyne, 2018; Wareham et al. 2014). This approach substantially limits our understanding to a small set of technologies and overlooks a number of other relevant relationships with external actors (Gawer & Cusumano, 2014; Gorwa, 2019; Skog et al. 2018). This paper proposes to extend the study of boundary-making mechanisms to a broader spectrum of relationships and technologies that are used to govern and control the exchange of resources across the whole ecosystem. It addresses two research questions: *How do technologies shape both the drivers and mechanisms of boundary-making?* And *how do technologies shape and reconfigure relationships, actors and roles?*

This paper provides a rich account of how TripAdvisor has thrived on the exchange of resources with its external environment. In particular, this paper outlines the various mechanisms by which TripAdvisor has been able to establish, govern and grow its now

robust ecosystem. This account differs from the existing literature in two distinct ways. First, it encompasses 14 types of actors that have engaged with TripAdvisor over time, none of whom can be classed as third-party developers. Second, it indicates several technologies (i.e. web syndication, web crawler, RSS) apart from APIs and SDKs that are used as boundary resources. No doubt that APIs and SDKs are prevalent technologies these days. Nevertheless, they alone cannot account for the long-term transformation of the platform's relationships neither for the evolution of its mechanisms of value creation and value capture.

The findings support the thesis's argument by underscoring the critical role played by technology. Rather than being simply tools or conduits, technology has played a significant role in determining both drivers and mechanisms of boundary-making and in speeding up transformation within the ecosystem. The study suggests that technology has a dual influence on boundary-making as "technology-as-resource" and "technology-as-governance". On the one hand, technology is an external resource to be controlled, co-opted, and governed as it often complements existing IT capabilities or data sources. In this way, the platform makes strategic choices by considering the manner to gain existing technological resources in its environment and accordingly forms their connections and alliances.

On the other hand, technology substantially intervenes in shaping how the platform organisations control their boundaries. Technologies drive entirely different scenario of enforcement and control (Kallinikos, 2011; Kallinikos et al., 2013; Lessig, 1999). This "digital" logic of control is highly specific to a given technology (Kallinikos, 2011). For instance, TripAdvisor developed specific technologies for booking, monitoring, and exchanging real-time data that allowed TripAdvisor to automate booking advertising.

Contrasting substantially from before, booking advertising applied and controlled via automated tracking and real-time monitoring of all the partners booking activities (including a new actor - IBEs). In so doing, booking advertising went from mostly contractual-based rules to automated-based rules, and partnership conditions moved from being established ex-ante to ex-post.

In addition to these, the study found that boundary-making reflects a fundamental strategic choice which has consequences not only for the platform's business model and expansion opportunities but also for the evolution of the entire ecosystem within which the platform is embedded (Gawer & Cusumano, 2014; Jacobides et al., 2018). For example, the implementation of booking advertising provoked the reconfiguration of the relationships in the ecosystems, and the emerges of complex multilateral dependences. TripAdvisor's main clients (OTAs) became co-opetitor[22], hoteliers became clients, and IBE began as partners.

Recapitulation and Contributions

This dissertation began by recalling the Facebook and Cambridge Analytica scandal that was disclosed in 2018 – a massive exploitation of Facebook user data that was, in turn, used to influence voting in the 2016 US presidential elections. This scandal served to raise general awareness of the existence of large-scale data operations to procure, process and trade users' clicks across a broad spectrum of digital platforms (Alaimo & Kallinikos, 2017; Alaimo et al. 2020 [Paper One]; Gerlitz & Helmond, 2013; Zuboff, 2019). The implications of data operations have been largely overlooked by in IS and Management research. These data operations, however, have played a crucial role in how social media

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[22] Term used to denote that two actors engage in a dual relationship. They cooperate while compete

platforms have become what they are today (Alaimo et al. 2020 [Paper One]; Bowker, 2019; Gerlitz & Helmond, 2013).

Social media's expansion into increasingly commercial operations has gone hand in hand with technological advances and the permeation of social media into daily life. Studying the underlying data operations that sustain social media platforms as economic organisations involves paying serious attention to the structuring role of technology and data. Only a limited number of scholars have so far embarked on this endeavour (e.g. Alaimo & Kallinikos, 2016, 2017; Bucher, 2012; Kallinikos & Tempini, 2014; Niederer & van Dijck, 2010; Tempini, 2015).

Given this background, this dissertation sought to uncover the underlying technologies and data operations through which social media platforms have sustained their commercial relationships and their increasing involvement in the digital economy. To this end, the thesis explored the patterns of TripAdvisor's operational transformations from its establishment in 2000 through 2019. By analysing empirical evidence, the thesis identified various stages in the evolution of TripAdvisor that can contribute to understanding the platform's current position within the online travel ecosystem.

Each of the three papers that comprise this thesis provides a distinct but complementary view of the evolution of TripAdvisor. Furthermore, all three papers place technology and data at the centre of the inquiry. These papers investigate the structuring nature of data and technology that shapes economic and social relations and frame what actors can or cannot do. In particular, the papers meticulously examine the technological, organisational, and economic configurations that underpin the evolution of TripAdvisor. The empirical observations from the case study of TripAdvisor formed the basis on which

to inductively develop theoretical propositions concerning the evolution of social media platforms and the ecosystem formation.

This thesis makes significant contributions to the field of digital platforms, platform evolution and ecosystem. Although each paper has its own contributions to make, taken as a whole, they develop a framework that helps to explain the structural transformations of social media platforms and their current embeddedness in webs of commercial relationships that are characteristic of the digital economy.

The paper One (Chapter 2) primarily contributes by advancing two concepts. First, it defines a data-based service as complex and dynamic assemblages of different types of data that describe, stage, and moderate the relationships of ecosystem actors (Alaimo & Kallinikos, 2017, 2019b). Data-based services emerge out of the complex interactions between the prevailing practices of data generation and exploitation and the development of deliberate strategies and platform functionalities. The capability of a digital platform to assemble such services is a critical precondition for forging a web of commercial relationships.

Second, the paper advances the notion of complementarities and ecosystem by pointing out the distinctive nature of the ones achieved via the medium of data. Data complementarities significantly contrast with physically embedded ones as they are reconfigurable and updatable in ways that other complementarities can hardly ever be. By surpassing the inherent constraints of physical resources to which industry formation has been bound (Kallinikos, 2007), data complementaries allow to crossing industry and activity boundaries in many and unexpected ways (Henfridsson & Lindgren, 2005; Santos & Eisenhardt, 2005; Yoo et al., 2010). This characteristic may suggest that ecosystems that rely upon such data complementarities are prone to lead to the emergence cross-

industry ecosystem and innovation on a larger scale (Kallinikos et al., 2013; Yoo et al., 2010).

The paper Two (Chapter 3) makes a number of contributions to the existing theories of digital platforms and platforms' evolution. It provides a new theoretical lens by linking high-level explanatory concepts to lower-level technologically mediated operations that lie behind the end-user interfaces. This lens, on the one hand, facilitates the study of the detail of the technological fabric that sustains digital platform operations. On the other hand, it highlights the often-overlooked role which technological processes play in materialising strategies and shaping the platform's operational profile. In this way, it reveals that the platform's profile is closely associated with a particular configuration of technologies, digital objects, roles, and practices that sustain end-user interfaces. This paper also contributes by revealing the importance of users as active generators of data which have an essential role in sustaining the platform' operations.

In addition to these contributions, this paper introduces new methods to study digital platforms. It combines a number of computational tools to collect and analyse the mutations in the structure and layout of TripAdvisor's end-user webpages interfaces. In so doing, this paper highlights the importance of end-user interfaces as empirical evidence as they provide a window to obtain a detailed insight into everyday operations.

Paper Three (Chapter 4) contributes to the existing theories by expanding the understanding of boundary-making and boundary-resources in digital platforms. It reveals that technologies have a more substantial role in influencing both the drivers and mechanisms of boundary-making than the current theories credit them. The paper implies that boundary-making is mostly a matter of control that, in digital platforms is driven and governed not only by different (digital) tools but by a different (digital) logic of control.

To signal the dual influence of technology on boundary-making, it is called "technology-as-resource" and "technology-as-governance".

Limitations and Further Research

In spite of the contributions made by the thesis, some limitations remain. The thesis represents the first foray into both studying the evolution of social media platforms and paying serious attention to the role of technology and data on their operations. This approach is both the principal strength and limitation of this thesis.

Social media platforms give easy access to users to connect and use them. However, these platforms hardly ever provide access to their inside. These businesses organisations, in fact, have strict confidentiality policies in place for their IT employees to warranty the secrecy of their technological operations. Given the difficulty of establishing contact with TripAdvisor, this study traces TripAdvisor's history and answers its research question chiefly by means of secondary data from TripAdvisor's media centre and the Wayback Machine archives. Digital records from the media centre archive provide a public account of events that marked TripAdvisor's history and the Wayback Machine archive documents TripAdvisor's webpages over time. They provide a good testimony of the relevant events, relationships and operations in which TripAdvisor has engaged. Though the use of secondary data may see as a limitation, it opens up the possibility of employing new methods and analytical approach to studying digital platforms, including social media platforms.

The thesis uses a case study, and its findings cannot be generalised at the population base; rather, the case study enables analytical generalisation. This generalisation is a gradual process in which empirical observations are contrasted with theoretical ideas to develop analytical propositions concerning the given phenomenon, which was in this study, the

evolution of social media platforms. The generalizability of a case study depends on the choice of the case study (Chapter 1: Research design) and a set of quality criteria and good practices (Chapter 1: Quality and validity). To meet these quality criteria, this research followed three principles proposed by Yin (2009): use multiple sources of evidence, establish a case study database, and maintain a chain of evidence. Though a case study has its drawbacks in terms of population base generalisation, it is the best option for developing theoretical/conceptual frameworks that provide insightful explanations of a complex phenomenon in order to guide future studies. Besides, other social media companies such as Facebook, YouTube or LinkedIn have undergone similar changes than TripAdvisor. These changes are indications that the findings transcend their relevance, considerably beyond TripAdvisor.

This research contributes to the study of the evolution of social media platforms. However, being one of the few studies that critically analyses the role of technology and data in their operations and digital platforms evolution, further research is called for, that extends beyond single cases to make comparisons across platforms and industries. On the light of the thesis' findings, various line of inquiring could be further explored. Some ideas are sketched below.

This thesis studies the formation of an ecosystem, and its dynamics focuses on one platform, TripAdvisor. The findings reveal that the platform has forged a wide range of relationships with other platforms, which in turn favour the emerge of multilateral dependencies that are non-hierarchical controlled (Adner 2017; Jacobides et al. 2018). The thesis also found that the evolution of the platform is to some degree, inextricably bound up with the ever-present quest to achieve a tuning with its environment (Eaton et al. 2015). Giving this scenario, an appealing avenue for future research would be to

change the unit of analysis from the predominant view on a focal platform to the ecosystem of platforms as a whole. In this way, a full range of questions about the evolution and dynamics of ecosystems emerge. For instances, How is the evolution of platform ecosystems linked to broader technological advances? How do technologies shape and reconfigure platforms position and role within the ecosystem? What sort of multilateral dependencies among ecosystem actors are established? How such dependencies have an impact on the platform position within the ecosystem?

The thesis outlines the high probability that cross-industry ecosystems and larger-scale innovation will emerge prone by the development of data complementarities (Kallinikos et al., 2013; Yoo et al., 2010). These ideas required to be further explored by studying, for example, the technological and organisational capabilities that sustain the cross-industry ecosystem of platforms.

Concluding remarks

Social media platforms have become omnipresent in our everyday life in a way that it is difficult to picture a day without connecting to them. They have turned the details of our lives into data while expanding their web of commercial relationships and are firmly embedded in the digital economy. Given their relevance, social media platforms as economic organisations demand to be better understood, while taking into account the role of users, who furnish the platforms with their distinctive characteristics. This dissertation sought to respond to this need by scrutinising the role played by technology and data in the evolution of social media operations and social media's current status within the digital economy. It, thus, addresses the theoretical concerns set out in the introduction of the thesis.

This thesis reconstituted the structural transformations of TripAdvisor from its establishment in 2000 to 2019. The analysis revealed several stages in TripAdvisor's evolution: from search engine to data services platform. Each stage roughly corresponded to a specific set of technological and organisational capabilities for exploiting data across organisational and industry boundaries. This thesis makes visible the role of users as active generators of data, a significant factor which is often underestimated. Users' actions and preferences are turned into data that, after complex processes of transformation, become assets to trade or form the basis of services.

The thesis makes relevant contributions to the existing literature on digital platforms, including social media platforms and platform evolution. Through a succession of three papers, it describes the technological, organisational, and economic complexities of the evolution of social media platforms. It emphasises that, in order to gain a sophisticated understanding of such evolution, it is important to look at relationships between changes to the platform and the technological conditions and practices by which they have been achieved. The thesis also contributes to the field of study by proposing a theoretical lens to study in detail the technological fabric that sustains digital platforms' operations. This lens highlights the often-overlooked role which technological processes play in materialising strategies and shaping the platform's operational profile.

Additionally, the thesis makes two particular contributions to the current theories of ecosystems. First, it unveils the role of data and the technological conditions which form the basis for emerging commercial relationships across platforms and industries. Economic relationships forge via the medium of data are highly reconfigurable and updatable. The nature of these relationships leads to a constant redefining of organisations and industries' boundaries in several and unexpected ways. Second, the thesis discloses

the fluid nature of these ecosystems, a characteristic that even though it has been acknowledged, has not been studied in detail. In this way, this study contributes by exposing the critical role played by technology in shaping the configuration of commercial relationships and actors within digital ecosystems. Rather than being simply tools or conduits, technologies intervene both by determining drivers and mechanisms by which relationships are forged and by speeding up transformation within the ecosystem.

In this hyper-technological age in which data have become a vital currency, the thesis highlights that strategies, operations, data, and technology are inseparable and deserve to be studied in tandem. This research represents the first foray into studying the evolution of social media platforms and one of the few studies that critically analyses the role of technology and data in their operations. Needless to say, further research is called for, especially studies that extend beyond single cases to make comparisons across platforms and industries.

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Appendix 1: About section evolution

01/09/2000 to 19/03/2001
Search Engine & Travel database

02/05/2002 to 29/03/2005
Search Engine & CPC marketing

Search Engine

24/04/2005 to 08/05/2006
UGC & CPC marketing

13/06/2006 to 08/05/2007
Community & CPC marketing

23/05/2007 to 30/06/2010
Media Network & CPC marketing

Social media

04/08/2010 to 11/02/2015
Booking & Community

19/05/2015 to 19/04/2017
Price comparison added

23/05/2017 to 01/07/2019
Wisdom of Crowd added

02/07/2019 to Now
The world's largest travel platform

End to End services

203

Appendix 2: TripAdvisor's hotel layout evolution

The result of the manual analysis of hotel webpages was four layout model, one per TripAdvisor's stages. Each model provides a visualisation of a specific configuration of digital objects embedded in the webpages. The background colours represent the primary source of data needed to generate the digital objects. Digital objects with a green background are generated base on data that TripAdvisor has. The blue background is assigned to digital objects that encourage end-user to generate content, or they are the UGC themselves. The purple background signals digital objects that generate on the basis of data objects which bear upon the intensive processing of users' activities and preferences. Digital objects with a pink background are social data or served to generated social data (i.e. social buttons). The yellow background represents digital objects that display content generated by businesses' owners. Orange indicates digital objects that link to external webpages. The dotted line with a scissor divides the layout snapshot model in two to signal that the upper part was visible at first glance.

Figure 15 illustrates the layout of the hotel's webpages between 2001 and 2003. The contact hotel information does not have any colour as it was not possible to trace from where these data were procured. In general terms, the hotel's webpages were static ones that aggregate travel articles and travel products by developing content links and commerce links both in orange. The abundance and highlighted position of digital objects with orange background illustrate the relevance of the content and digital resources that came from external sources in building hotel's webpages in this period.
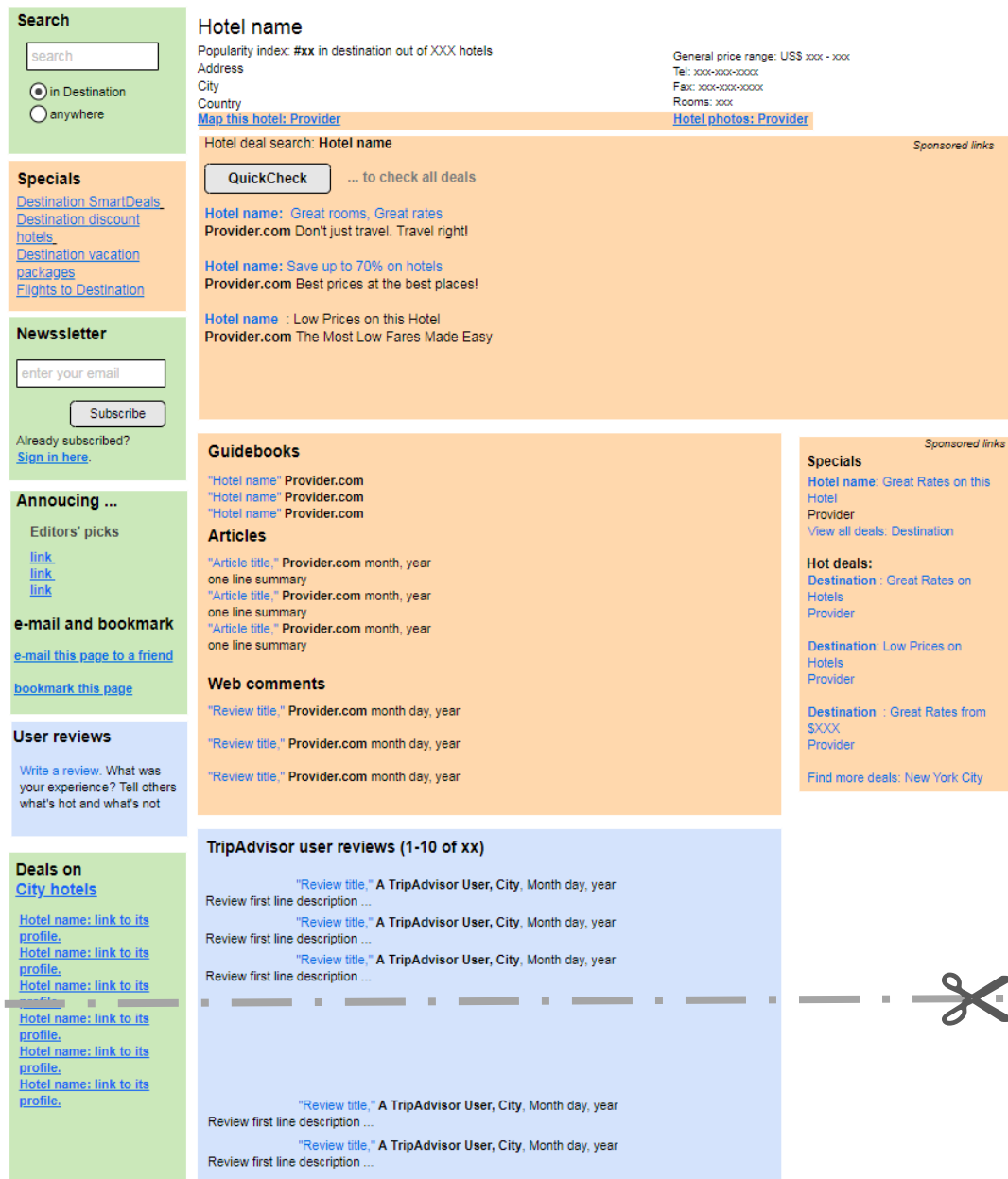
Search

search

◉ in Destination
○ anywhere

Specials

Destination SmartDeals
Destination discount hotels
Destination vacation packages
Flights to Destination

Newssletter

enter your email

Subscribe

Already subscribed?
Sign in here.

Annoucing ...

Editors' picks

link
link
link

e-mail and bookmark

e-mail this page to a friend

bookmark this page

User reviews

Write a review. What was your experience? Tell others what's hot and what's not

Deals on City hotels

Hotel name: link to its profile.
Hotel name: link to its profile.
Hotel name: link to its profile.
Hotel name: link to its profile.
Hotel name: link to its profile.
Hotel name: link to its profile.

Hotel name
Popularity index: #xx in destination out of XXX hotels
Address
City
Country
Map this hotel: Provider

General price range: US$ xxx - xxx
Tel: xxx-xxx-xxxx
Fax: xxx-xxx-xxxx
Rooms: xxx
Hotel photos: Provider

Hotel deal search: Hotel name   Sponsored links

QuickCheck   ... to check all deals

Hotel name: Great rooms, Great rates
Provider.com Don't just travel. Travel right!

Hotel name: Save up to 70% on hotels
Provider.com Best prices at the best places!

Hotel name : Low Prices on this Hotel
Provider.com The Most Low Fares Made Easy

Guidebooks   Sponsored links

"Hotel name" Provider.com
"Hotel name" Provider.com
"Hotel name" Provider.com

Articles

"Article title," Provider.com month, year
one line summary
"Article title," Provider.com month, year
one line summary
"Article title," Provider.com month, year
one line summary

Web comments

"Review title," Provider.com month day, year

"Review title," Provider.com month day, year

"Review title," Provider.com month day, year

Specials
Hotel name: Great Rates on this Hotel
Provider
View all deals: Destination

Hot deals:
Destination : Great Rates on Hotels
Provider

Destination: Low Prices on Hotels
Provider

Destination : Great Rates from $XXX
Provider

Find more deals: New York City

TripAdvisor user reviews (1-10 of xx)

"Review title," A TripAdvisor User, City, Month day, year
Review first line description ...
"Review title," A TripAdvisor User, City, Month day, year
Review first line description ...
"Review title," A TripAdvisor User, City, Month day, year
Review first line description ...

"Review title," A TripAdvisor User, City, Month day, year
Review first line description ...
"Review title," A TripAdvisor User, City, Month day, year
Review first line description ...

Figure 15. Hotel profile 1st-period model

Figure 16 illustrates the layout in the second stage of TripAdvisor. In this period, TripAdvisor began to increasingly rely on computational methods of data processing rather than manual operations characteristic of the first period. It developed filters and sorting options for reviews. In this way, users were able to see reviews by specific language or rate, as well as order by date or rates. In addition, an overview of the reviews given to a specific hotel was added (see Figure 16 A). In so doing, hotels were reduced into twelve categories defined by TripAdvisor (e.g. overall rating in rooms, service, value,

cleanliness and dining). In so doing, hotels became comparable, and the user experience reduces into data. This period also arrived *Similar Hotels Nearby,* a recommender system (see Figure 16 B). This period did not show significantly different from the previous period. However, UGC (blue) acquired growing importance at the expense of external content (orange). Filters, overviews and recommender system implies an augmented use of computational methods and the building of data capabilities denotes the beginning of the production of data objects.

Figure 17 exemplifies the hotel's webpages during the third period. This period marked the beginning of "social" digital objects. While pink denotes digital objects that produce or are social data, purple denotes data object generated from social data. Helpful labels (see Figure 17 B), a social button, were displayed on each review. This button accounted for users' votes with respect to the usefulness of a review providing a way to commensurate them. In this period, TripAdvisor began to develop digital objects that bear upon data objects from Facebook via social graph API (see Figure 17 C, D and E). In addition, the overview of the reviews was updated by adding the section "*What travellers say*" (see Figure 17 A). These data probably were derived by mining the reviews of the hotel. To do this, reviews were processed to obtain the most frequent words among them, and then these reviews were parsed and aggregated under these keywords.

Figure 18 exemplified the hotel' webpages from the last period that began in 2013. The most notorious change in this period is that UGC digital objects (blue) were moved to a secondary position. At the same time, content added by the business owners (yellow) and real-time price comparison (orange) were seen at first glance. The activities or content that business owners were able to do or add were defined by the type of subscription subscribed with TripAdvisor. Figure 19 shows what subscribed were able to do.

Search

search

go

Destination Menu

Destination Overview

Destination Hotels

Flights to Destination

Destination Deals

Destination Attractions

Destination Restaurants

Destination Forum

Destination Maps

Destination Discount Hotels

Destination Vacation Packages

Newsletter

Email Address

User reviews

Write a review. What was your experience? Tell others what's hot and what's not

Deals on City hotels

Hotel name: link to its profile.
Hotel name: link to its profile.
Hotel name: link to its profile.
Hotel name: link to its profile.
Hotel name: link to its profile.

Hotel name: link to its profile.

Hotel name
Address

- Rooms: xxx
- Hotel class: ★★★
- TripAdvisor traveler rating: ◎◎◎◎◎
- **Call now to book: 1-800-434-6835 from provider.com**
- Map this hotel: Provider.com, Map this hotel: Provider
- Hotel photos: Provider.com, Hotel photos: Provider
- Virtual tour: Provider.com
- View candid traveler photos

Popularity Index

#X

of XXX hotels in Destination

QuickCheck

Travelers' choice award
award category
Description

Hotel deal search   Sponsored links

Hotel name: Great rooms, Great rates
Provider.com Don't just travel. Travel right!
Hotel name: Save up to 70% on hotels
Provider.com Best prices at the best places!
Hotel name : Low Prices on this Hotel
Provider.com The Most Low Fares Made Easy

Traveler Reviews   WRITE A REVIEW   POST PHOTOS

Language: Options ▼   Sort by: Options ▼

Reviews (1-10 of xxx)

◎◎◎◎◎   Month day, year   "Review title," **A TripAdvisor User**, City, Review two line description Review two line description …

◎◎◎◎◎   Month day, year   "Review title," **A TripAdvisor User**, City, Review two line description Review two line description …

Review Summary

Traveler Rating
Overall

What to expect
◎◎◎◎◎ Rooms
◎◎◎◎◎ Service
◎◎◎◎◎ Value
◎◎◎◎◎ Cleanliness
◎◎◎◎◎ Dining

Recommendations
business travelers
couples and romantics
honeymooners
singles
seniors

A

Banner

◎◎◎◎◎   Month day, year   "Review title," **A TripAdvisor User**, City, Review two line description Review two line description …

◎◎◎◎◎   Month day, year   "Review title," **A TripAdvisor User**, City, Review two line description Review two line description …

◎◎◎◎◎   Month day, year   "Review title," **A TripAdvisor User**, City, Review two line description Review two line description …

Sponsored links

Specials

Hotel name: Great Rates on this Hotel
Provider
Hotel name: Great Rates on this Hotel
Provider
Hotel name: Great Rates on this Hotel
Provider
Hotel name: Great Rates on this Hotel
Provider
View all deals: Destination

Similar Hotels Nearby

Hotel name
Ranks #xx
Hotel class: ★★★★★
Avg. price: $xxx/night

Hotel name
Ranks #xx
Hotel class: ★★★★★
Avg. price: $xxx/night

Hotel name
Ranks #xx
Hotel class: ★★★★★
Avg. price: $xxx/night

Hotel name
Ranks #xx
Hotel class: ★★★★★
Avg. price: $xxx/night

Hotel name
Ranks #xx
Hotel class: ★★★★★
Avg. price: $xxx/night

B

◎◎◎◎◎   Month day, year   "Review title," **A TripAdvisor User**, City, Review two line description Review two line description …

From Around the Web

Expert Guidebooks
"Hotel name"   Provider.com
"Hotel name"   Provider.com
"Hotel name"   Provider.com

Recent Articles
"Article title," one line summary   **Provider.com**   month day, year
"Article title," one line summary   **Provider.com**   month day, year
"Article title," one line summary   **Provider.com**   month day, year

Related Web Comments
"Review title,"   **Provider.com**   month day, year
"Review title,"   **Provider.com**   month day, year
"Review title,"   **Provider.com**   month day, year

Inside

Title	Edited by	Time/Date Posted
Inside title	editor	12:00 am, yesterday
Inside title	editor	12:00 am, yesterday
Inside title	editor	12:00 am, yesterday
More Inside		

Forums

Title	# of Replies	Most Recent Reply
Forum title	# replies	12:00 am, yesterday
Forum title	# replies	12:00 am, yesterday
Forum title	# replies	12:00 am, yesterday
Go to the city Forum		
Post a forums topic about Hotel name		

Title	# of Replies	Tme/Date Posted
Forum title	# replies	12:00 am, yesterday
Forum title	# replies	12:00 am, yesterday
Forum title	# replies	12:00 am, yesterday
Browse discussions		

goLists

Title	Date	Author
goList title	month day, year	nickname
goList title	month day, year	nickname
goList title	month day, year	nickname
View all goLists		
Create your own goList		

Figure 16. Hotel profile 2nd-period model
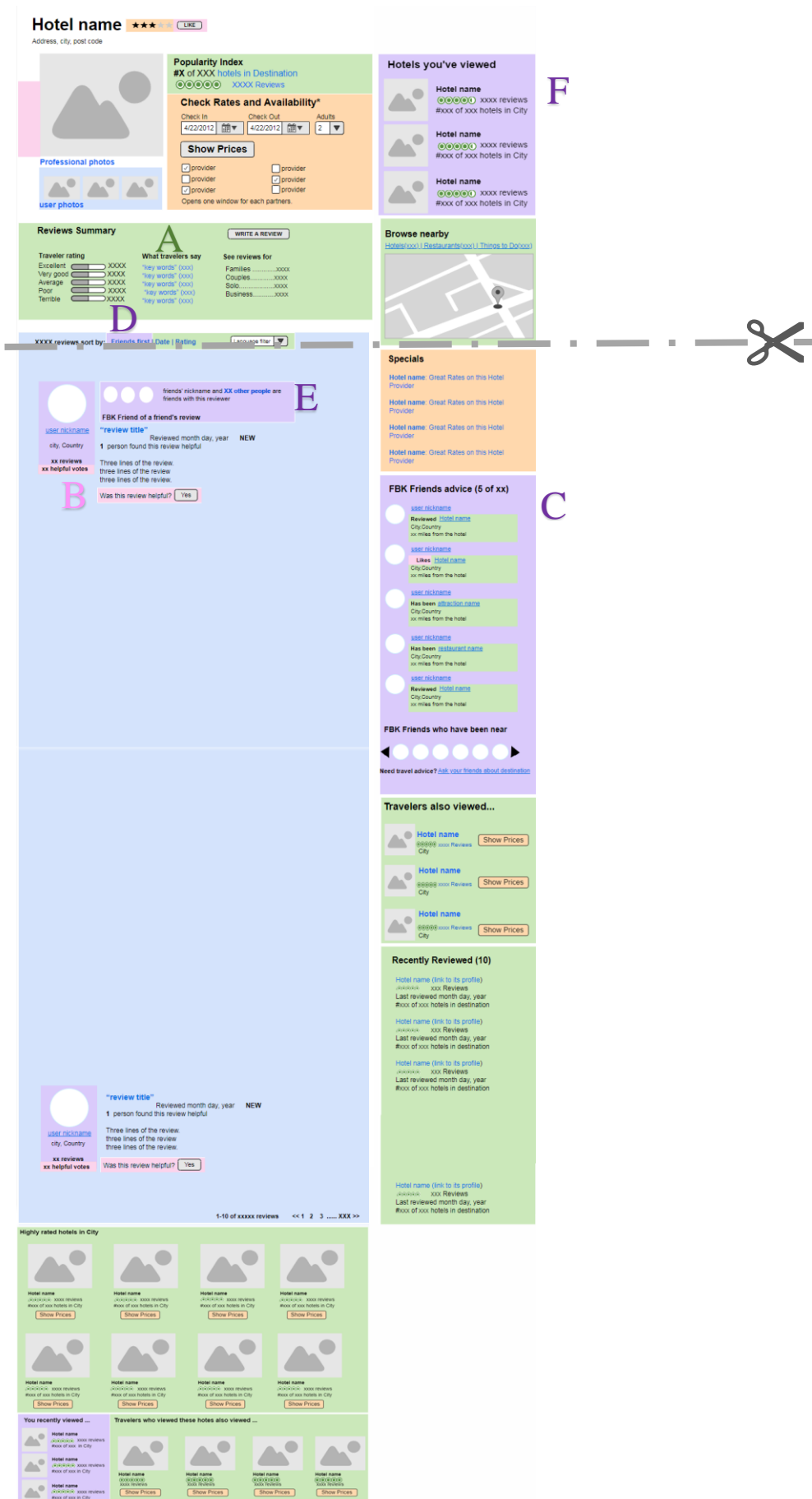
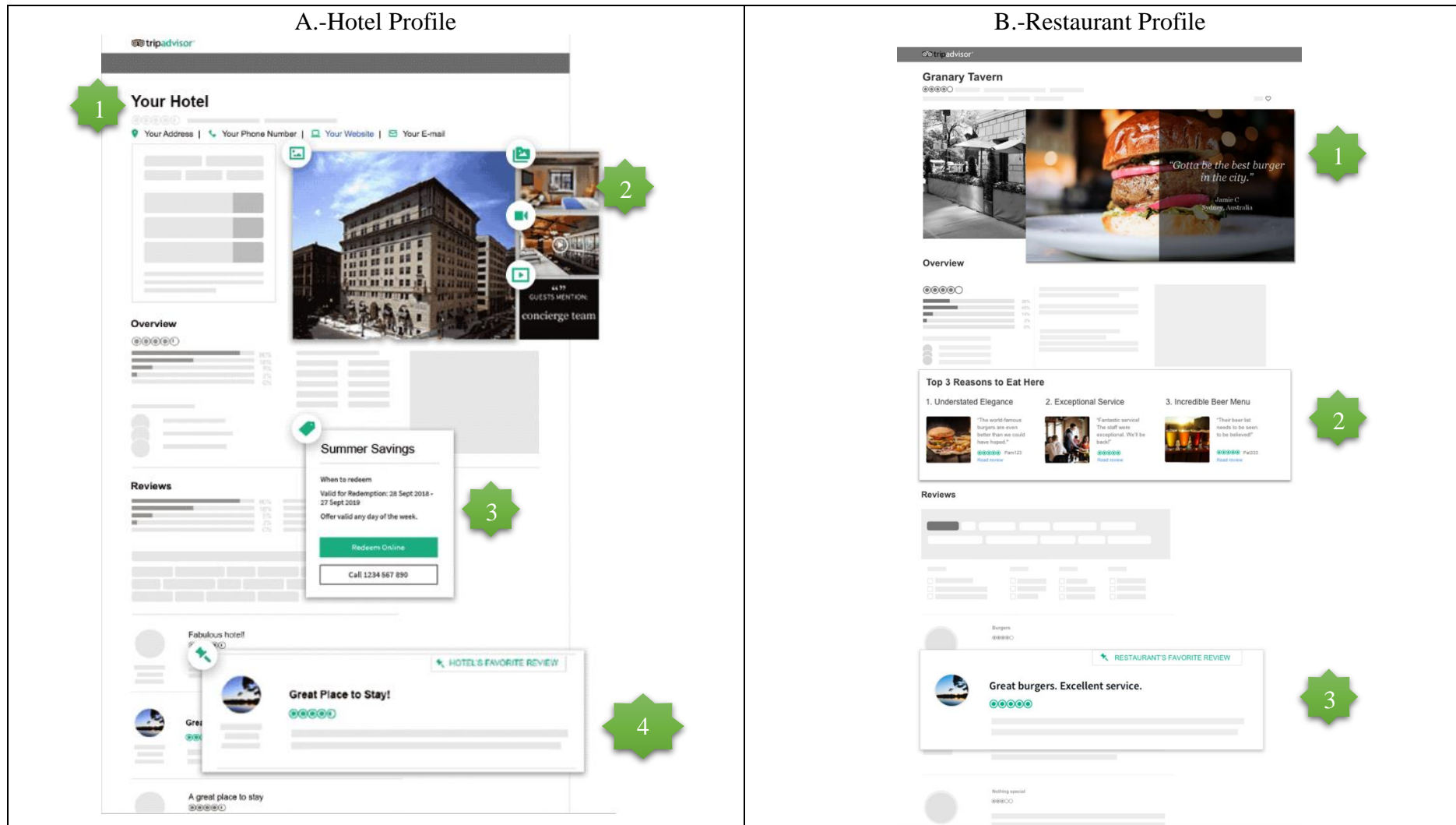**Figure 17.** Hotel profile 3rd-period model

Figure 18. Hotel profile 4th-period model

Figure 19. Business owner's subscription