

# Bridging the Distance: The Agencement of Complex Affordances on Social Media Platforms

*Completed Research Paper*

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## Abstract

*This research focuses on the actualization of technological affordances in complex technological environments, such as social media, where in addition to human and material agents, algorithmic agents also proliferate. Unlike material agents, algorithmic agents can act in the absence of proximal instigation by human agents, and can influence the actions of other agents distanced in space and time. By borrowing from actor-network theory, this paper foregrounds the role of algorithmic agents in the actualization of complex affordances by advertisers on a social media platform. It is illustrated that a complex affordance is actualized through an agencement, that is, a collective enactment of heterogeneous agencies. Through such an enactment, human agents are able to act at a distance too. This research highlights that in addition to material features of the user-interface, the underlying algorithms of a complex technology also partake in the actualization of affordances.*

**Keywords:** Social media affordances, complex affordances, algorithmic agency, action at a distance, actor-network theory

## Introduction

Social media platforms, such as Facebook, Twitter, Myspace, LinkedIn, and YouTube, afford organizations the ability to communicate (Treem and Leonardi 2012) with extra-organizational stakeholders. Affordances, understood as possibilities for goal-oriented action provided by these platform-based technologies (Markus and Silver 2008), have resulted in these technologies becoming pivotal for marketing, advertising, and brand building activities. With individuals and organizations increasingly adopting these platforms for communication, there has been an exponential rise in the amount of content being generated on social media platforms. Consequently, most platforms have designed algorithms that manage this deluge of content by presenting the most relevant information to their users. Unlike traditional information technologies, these algorithms continuously run in the backdrop of social media platforms without requiring explicit invocation by social media users.

Heretofore, literature has suggested that affordances actualize when a human agent *proximally* and explicitly instigates the material features of a technology (for example, Majchrzak, Faraj, et al. 2013; Treem and Leonardi 2012). We refer to such affordances as ‘proximal affordances.’ Contrarily, in this research, we delineate how algorithmic agents, *without explicit* invocation, affect the actualization of affordances on social media platforms. We refer to such affordances that do not require proximal and explicit instigation as ‘complex affordances.’ We investigate the social media marketing activities of an organization to foreground the role played by algorithms in actualizing affordances in such a context.

Social media technologies are unlike traditional information systems due to the characteristics of the algorithms that underlie the former. In traditional information systems, ‘algorithms’ underlying the system are responsible for carrying out automated computations on overwhelming quantities of data (Orlikowski and Scott 2015) such as calculating, sorting, classifying, etc. However, in social media technologies, the algorithms underlying the platforms are designed to also learn from the behavior exhibited by users by aggregating information about their actions (Beer 2009). For example, Facebook’s algorithms decide the relevance of an ad to a particular user based on the actions performed by *all* its users on *all* active ads on the platform. Hence, these algorithms exercise their ‘algorithmic agency’ and affect the actions of other agents (Andersen et al. 2016). These algorithmic agents are responsive to the inputs that they receive from the environment in light of their previous learning. Furthermore, algorithmic agency on these technology platforms is exercised without explicit instigation, unlike material agency of information systems that gets activated only when a user explicitly invokes it. For instance, a Facebook user’s preference for specific content gets registered only when s/he explicitly clicks on the ‘like’ button and invokes Facebook’s material agency. Conversely, the algorithms that identify the most relevant content for a user’s News Feed (an ongoing list of content potentially of interest to the user) do not require any explicit invocation.

Despite the proliferation of phenomena governed by algorithmic agents, most research on technological affordances so far, has either dealt with scenarios where algorithmic agency is absent (for example, Hultin and Mähring 2014), or has overlooked the role of algorithmic agency when it is present (for example, Majchrzak, Faraj, et al. 2013). In order to understand the actualization of complex affordances in the context of social media, it is necessary to go beyond the ‘form’ and ‘function’ (Kallinikos 2012) of technology, and include algorithmic agents which can act without invocation. However, the ability of these algorithmic agents to influence and be influenced by the experiences of users *distanced in space and time* makes exploration of their agency a methodological challenge. The current literature with its emphasis on ethnography and grounded theory as methods of enquiry, has only been able to superficially foreground the role that these algorithms play (Martini et al. 2013; Orlikowski and Scott 2015). In order to highlight and theorize the role played by algorithmic agents that are capable of *acting at a distance*, we depart methodological from current literature. We borrow from actor-network theory (ANT) whose methodological and theoretical premises provide us the language and the means to study how action at a distance may unfold (Latour 1987).

In this paper we explore social media marketing practices of an e-commerce firm on Facebook, a public social media website. The peculiarity of a public social media platform in comparison to an enterprise social network is that the features and functionalities of the platform (such as, Facebook, Twitter, etc.) lie beyond the ambit of control of the user organization (cf. Leonardi 2011). Hence, the organization is susceptible to the full force of the influence of algorithmic agents running in the background of the technology. The sole use of public social networks for marketing and branding by the organization that we study helped us in highlighting and foregrounding the salient role of algorithmic agency. In this paper, we empirically illustrate the actualization of three affordances for advertising on Facebook. We show that affordances on social media platforms are not the mere provisions of a particular technical object (Hutchby 2001; Markus and Silver 2008). Rather, these complex affordances are *agencements* (Callon 2007); that is, they are actualized through a collective enactment of heterogeneous agencies (Çalışkan and Callon 2010). We show that by acting on distant places, people, and events, algorithmic agents allow human agents to act at a distance as well. We describe how the advertiser acts at a distance by becoming a center of calculation that aggregates and acts upon information brought back from distant users as inscribed artifacts (Latour 1987). Furthermore, we illustrate that the actualization of complex affordances may involve and be conditional upon the actualization of other proximal affordances by human agents.

The paper is organized according to the following scheme. We start with the theoretical background, and then present the research context. This is followed by explication of the methodology. Thereafter, we present our findings along with a detailed discussion. We conclude with contributions to theory and practice.

## Theoretical Background

### *Affordances of social media technology*

The *theory of affordances*, rooted in the area of Ecological Psychology, posits affordances as what the environment offers, provides or furnishes an animal (Gibson 1986). For example, a horizontal, flat, rigid, and extended surface is stand-on-able, walk-on-able, and run-on-able for bipeds and quadrupeds. Norman (1988) was the first to apply the notion of affordance to technology and suggest that “an affordance is a relationship between the properties of an object and the capabilities of the agent that determine just how the object could possibly be used” (2013, p. 11). This relational character of affordances implies that they are more than mere properties of the object (Bloomfield et al. 2010) and are agnostic to particular features of the technology (Treem and Leonardi 2012). The concept of affordance, hence, allows researchers to focus on what the combination of material features of the technology and organizational context afford users to do (Zammuto et al. 2007). As a result, Information Systems (IS) scholars have found potential in the affordance theory to better understand organizational use of information technology (Orlikowski and Barley 2001). Not surprisingly, therefore, an emerging body of literature is using the concept of affordances to explain social media phenomena. Table 1 illustrates some of the social media affordances identified in extant literature.

| Illustration from Literature     | Social Media Technology   | Affordances   |
|----------------------------------|---|---|
| Treem and Leonardi (2012)        | Wikis, social networking sites, blogs, social tagging applications, mircoblogging platforms | <ul style="list-style-type: none"> <li>• <b>Visibility</b> implies that social media affords users the ability to make their personal information, preferences and behavior visible to others.</li> <li>• <b>Persistence</b> means that communication through social media remains available long after it was originally produced.</li> <li>• <b>Editability</b> denotes that the user can create, and edit her/his communication on social media any number of times, before it can be viewed by others.</li> <li>• <b>Association</b> suggests that a user can be connected not only to other users but also content in the form of information and communication on social media.</li> </ul>  |
| Hallerbach et al. (2013)         | Online communities  | <ul style="list-style-type: none"> <li>• Affordance for <b>collaboration</b></li> <li>• Affordance for <b>pushing information</b> to users</li> </ul>   |
| Jarrahi and Sawyer (2013)        | Social media technologies for knowledge sharing   | <ul style="list-style-type: none"> <li>• Affordance for <b>expert locating and socializing</b></li> <li>• Affordance for <b>creating social awareness</b></li> <li>• Affordance for <b>infusion of innovative ideas</b></li> </ul>  |
| Majchrzak, Faraj, et al. (2013)  | Knowledge sharing platform (e.g. Wiki)  | <ul style="list-style-type: none"> <li>• <b>Metavoicing</b> affords a user to react to other users’ profile, content, activity, and presence.</li> <li>• <b>Triggered attending</b> affords a user to be informed about certain developments on a conversation of interest, allowing her/him to choose when to get involved in it.</li> <li>• <b>Network-informed associating</b> affords a user to see how users are connected to each other and to content, and how content is connected to other content, enabling more informed connections to be fostered.</li> <li>• <b>Generative role-taking</b> affords a user to take the lead role in order to sustain the online community and maintain dialogue by encouraging participation and resolving arguments.</li> </ul> |
| Majchrzak, Wagner, et al. (2013) | Wiki  | <ul style="list-style-type: none"> <li>• <b>Shaping</b> affords organizing content which is communally produced by users in an organizational Wiki.</li> </ul>  |
| Zheng and Yu (2014)              | Mircoblogging platform  | <ul style="list-style-type: none"> <li>• <b>Network scaling</b> affords expansion in the participants and resources available.</li> <li>• <b>Public enrolling</b> affords public to participate for a social cause.</li> <li>• <b>Agenda framing</b> affords creation of a shared goal.</li> <li>• <b>Transparency</b> affords transparency and accountability via public supervision.</li> </ul>   |

**Table 1. Social media affordances identified in literature**

Most of this literature espouses a view of affordances whereby affordances are actualized when human agency interacts with the materiality of a technology, and in so doing invokes the material agency of that

technology (Leonardi 2008, 2012). For example, Facebook affords its users association (Treem and Leonardi 2012) with content posted on the platform by providing ‘comment’, ‘share’ and ‘like’ buttons adjacent to the post. These users may interact with the materiality of these buttons, and actualize the affordance to get associated with the content. This notion of affordance implies proximity between the human agency of the actor and material agency of the technology (Demir 2015) such that direct interaction between the actor and the technology may lead to actualization of an affordance. For instance, the affordance of network scaling (Zheng and Yu 2014) on Twitter gets actualized only when a user explicitly presses the ‘follow’ button, and thereby invokes the material agency of the platform to connect to other users. However, the actualization of certain affordances, in the case of complex technologies like social media, is also contingent upon the specific materiality served to a particular user. For example, when a particular user posts some content on Facebook, who among other users will be able to associate with the post is conditional upon who will be shown the post in their News Feed. This implies that an affordance in complex technological scenarios is relational, not simply due to the dyadic relationship between human and material agency (Bloomfield et al. 2010). Rather, it requires us to direct attention towards an aspect that has, hitherto, received little attention; that is, the agency of algorithms that run in the backdrop of these technological platforms.

### ***Agency of social media algorithms***

Algorithms follow step-by-step instructions which reflect their designers’ assumptions (Orlikowski and Barley 2001). However, it is argued that the algorithms running in the backdrop of complex technological platforms, such as social media, not only act (Orlikowski and Scott 2015), but such algorithmic agents also affect the actions of other agents on the platforms (Andersen et al. 2016). Hence, algorithmic agents may play a critical role in determining the affordances that can eventually be actualized in practice on the platforms. We differentiate algorithmic agency from proximally instigated material agency (Leonardi 2012) on two counts. Firstly, algorithmic agency acknowledges complex decisions that algorithms perform by continuously learning the tastes, preferences and actions of the entire user base of the technology platform (Beer 2009); and secondly, algorithmic agency is unlike material agency which is physically proximate to human agency (Demir 2015). That is, algorithmic agency may be implicated by the actions of human agents who neither share the physical site of their actions, nor the time of their actions, with the spatio-temporality of the algorithms. Furthermore, by learning users’ preferences, algorithmic agents may subsequently influence the actions of these physically and temporally distanced human agents. For example, in tailoring the News Feed for a particular user, Facebook’s algorithms accounts for thousands of parameters regarding the previous behavior of temporally and spatially distanced users on its platform. Therefore, with which content a user actualizes the affordance of ‘association’ (Treem and Leonardi 2012) is based on what is served in her/his News Feed. Hence, actualization of affordances is subject to the *collective* agential acts *distributed* among humans, materials, and algorithms, all *distanced* in space and time from each other. The extant conceptualization of affordances (for example, Treem and Leonardi 2012; Zheng and Yu 2014) that assumed proximal and dyadic relationships between an object and an agent, which we refer to as proximal affordances, is insufficient to understand the possibilities for goal-oriented action in situations characterized by collective action by diverse agencies (Bloomfield et al. 2010), often at a distance, giving rise to, what we term as, complex affordances.

### ***Collective action by diverse agencies at a distance***

As explained above, action performed collectively by distributed and diverse forces is characteristic of complex technological phenomena. We, therefore, resort to Çalışkan and Callon (2010) who introduced *agencement* as a ‘methodological term designed to respect and render the diversity of these forces.’ *Agencement* implies a hybrid collective actualized by mobilization of a large number of human and non-human entities that partake in action within the collective. More specifically, *agencements* are defined as arrangements endowed with the capacity to act in different ways, depending on their configuration (Callon 2007). The advantage of the concept of *agencement* is threefold (Çalışkan and Callon 2010). First, it preempts the need for distinguishing between different categories of agency prior to analysis; second, it can be similarly used for micro- and macro-actors; and third, it allows action to either be shared among several entities or attributed to only one. We, therefore, find this notion of *agencement* beneficial to comprehend affordances in the context of social media, where different types of human, material, and algorithmic agencies acting individually and collectively proliferate and require equal treatment.

Further, to make sense of action at a distance, we follow Latour (1987) who suggests that in order to act on people, places and events at a distance, one needs to bring these people, places and events back. Bringing back the distant does not imply transporting these people, places, and events to a point in the literal sense. Rather it means devising extraordinary means that inscribe the distant into a form that represents the distant, often only selectively and incompletely. These extraordinary means or *inscriptions* (a) have the capability to render the distant people, places and events mobile, (b) can keep them stable as they travel back and forth without distortion, and (c) are combinable so that they can be accumulated, aggregated and shuffled. As these inscriptions start bringing back the distant to a point, a *cycle of accumulation* gets established and, the point becomes a center of accumulation, gathering information about the distant people, places, and events. In the case of Facebook, an ad serves as one such extraordinary means. When Facebook presents an ad to a user, the actions performed by the user on the ad, though performed in a different space-time, are rendered mobile as they get registered in the form of inscribed information. This information gets attached to the ad and travels with it without any distortion back to Facebook. Furthermore, Facebook's algorithms can also combine these ads, along with the inscribed information, into the News Feed of a user. However, this combination is the result of complex calculations that transform the Facebook platform into what Latour (1987) calls a *center of calculation*. The ads in the form of extraordinary means, enable calculations through the three steps suggested by Callon and Muniesa (2005). First, the inscriptions that carry information about distant users are moved, arranged and ordered in one calculative space, which is the social media platform itself; second, they are compared and manipulated on a common principle, which is encoded in the logic of the algorithms; and third, a result is produced through the operations performed on the inscriptions giving rise to a new entity or a higher-order inscription (Latour 1987), such as a list of recommended content in the form of a News Feed.

Current literature has called for defining social media by enumerating its affordances to allow for a nuanced understanding of the influence of social media on organizational practice (Treem and Leonardi 2012). However, this requires moving beyond a proximal and dyadic understanding of affordance as a relationship between an object and an actor. It also requires developing a detailed understanding by incorporating the distributed role played by users, technology, and underlying algorithms in social media settings. By investigating the context of Facebook where diverse agencies *collectively act at a distance*, we aim at developing such a nuanced understanding of complex affordances.

## Research Context

This paper is part of a larger research project that aims at unraveling the practices of firms empowered by electronic modes of commerce, new media, and new technologies. In this paper we present the findings from our fieldwork at a firm, henceforth referred to as OMEGA. This firm deals in smartphone cases and uses e-commerce as its only mode of transaction to sell these cases over its website. OMEGA depends solely on online channels for advertising its products, and expends the maximum time, money, and effort for advertising on Facebook. OMEGA's reliance on this public social media platform makes it a particularly appropriate site for our research, since, the features and functionalities of such a platform cannot be modified by OMEGA at will. This gave us the opportunity to foreground the agency of the algorithms running in the backdrop of the platform.

OMEGA was founded in mid-2012 as an online retail store dealing in accessory solutions across different lifestyle segments catering to Indian customers. Owing to the rising adoption of smartphones in India (EMarketer.com 2014), the company discontinued sale of all other accessories and solely entered the category of smartphone cases in January 2014. Though, the smartphone case was usually used for protecting the fragile body and screen of a smartphone, it provided a lucrative opportunity for designing or customization to improve the 'look' of the smartphone. The founders of OMEGA envisioned positioning designer and customizable cases as a medium of personal expression. They tied up with renowned designers from across the world through exclusive contracts. As of mid-2015, the company offered around 2000 designs for cases across 105 smartphone models, and had sold more than 120,000 smartphone cases.

At the time of our fieldwork, OMEGA was solely dependent on online channels for advertising its products and found social media channels the most potent for this purpose. Since awareness about a niche product like designer smartphone cases was low, marketers at OMEGA did not find search engine advertising

useful. They also believed that advertisements on online display networks solicit little response from Internet users and appear no more than a mere distraction on a webpage. While, the company had a presence on various social networking websites including Facebook, Twitter, Instagram and Pinterest, close to 90% of its total advertising budget was spent on Facebook. This paper explores the advertising practices of OMEGA on Facebook, with the purpose to understand the opportunities that such a medium affords for advertising, and their actualization in the wake of algorithmic agency underlying the social media platform.

## **Methodology**

Before delving into the field, a preliminary background research was conducted in order to gain insights into the practices and concerns of firms that primarily use e-commerce as their mode of transaction. Approximately twenty informal interactions were conducted in-person and telephonically which helped prepare a broad canvas of the context. During this phase we realized that, while ostensibly the firms' accomplishments appeared to be results of their own practices, these were in fact the result of actions performed by a gamut of heterogeneous human and non-human agents. It is the recurrence of non-human agency in our data that motivated us to choose Actor-Network Theory (ANT) as a method for data collection and subsequent data analysis. Being both a theory and a methodological approach (Latour 2005), ANT provided us with theoretical concepts, as well as, suggestions on carrying out empirical work (Walsham and Sahay 1999).

### ***Method***

Actor-Network Theory (ANT) was found to resonate well with the intent of this research to understand the accomplishments of firms as a result of entangled interrelationships between human and non-human elements (Walsham 1997). ANT accepts that both human and non-human actors can be the origin of actions (Latour 1990). Hence, agency is a privilege of not only humans, but, also non-humans, inanimate objects and artifacts (Callon and Latour 1992; Collins and Yearley 1992). These tenets were especially useful for us as we delved into a field replete with human, material, and algorithmic agents.

Drawing on ANT, we followed the various actors through their work to examine their diverse positions, controversies and outcomes (McLean and Hassard 2004). Interviews gave us the wherewithal to travel across space and time (Latour 1987) and collect accounts on not only the current actions, but also past doings of the organizational human actors. As we had expected, from the very beginning we encountered a heterogeneous cache of non-human agents including websites, blogs, software, algorithms, and artifacts. In the case of social media, prior research has found it challenging to empirically investigate software and algorithmic agents due to non-disclosure of details about them (Orlikowski and Scott 2015). Employing ANT as method, we were able to overcome the 'inscrutability' of these new actors on the scene by exploring material inscriptions in the form of websites, online user manuals and help pages, publicly available online articles, and developers' documentation. The prior training and experience of the researchers in technology assisted in making sense of the collected artifacts as we delved deeper into the technical aspects of the technical agents. As we followed the actors, a network of relations started emerging between these heterogeneous elements and we started tracing the work being performed in this network (Latour 2004).

### ***Data***

This study is based on data collected from April 2015 to April 2016. Since, the focal firm OMEGA is located in a different geographical region from the University where the authors are stationed, one of the authors made three trips for the purpose of data collection to the region where the firm is located. The three visits lasted 3 weeks, 5 weeks, and 4 weeks respectively. Multiple means were used for data collection on-site: interviews, informal discussions, and observation of the day-to-day practices of employees of the company. OMEGA, being an entrepreneurial firm, had a small team of less than forty employees, with majority of them involved in routine customer support, website design, and production. The two co-founders, along with the personnel responsible for marketing, operations, and technology functions were the primary decision makers and executives in the firm. Hence, they were identified as

important informants for this study. Nonetheless, the author also interacted informally with various other employees and visited the site on multiple occasions to observe and understand the workings of the firm.

To trace the relations constituting the actor-network, the author tried to gather as much information as possible about the day-to-day activities and roles of the informants. The author also tried to elicit a historical brief of the informants' stay at the firm during interactions with them. At the very start of an interaction, the author revealed her identity as a researcher and the purpose of her research to the informant. The informants were reassured that anonymity will be maintained and no comments will be attributed to them in any subsequent discussions or reporting (Miles and Huberman 1994).

Most interviews were conducted either on-site or telephonically in a semi-structured fashion. The average duration of an interview was approximately 90 minutes. All but three interviews were digitally recorded and due permission was taken from the interviewees before recording. Details of the interviews that were conducted are presented in Table 2. Notes were taken for the interviews that were not recorded. These were transcribed on the same day so that important details were not missed. A number of times communication was conducted over e-mail and instant messenger, primarily to clarify doubts and gather statistical information from the informants. A record of these interactions also formed part of the data corpus. Furthermore, the author also maintained a research diary to note her informal interactions with the employees and keep record of her observations on-site. In addition, the author collected some summary/statistical reports made available by Facebook to OMEGA regarding performance of its ad campaigns among the billions of Facebook users.

| Informant                                  | Number of interviews | Interview duration (hrs.) | Recorded                           |
|--|----------------------|---------------------------|------------------------------------|
| Co-founder & Chief Executive Officer (CEO) | 3<br>(1 telephonic)  | 4.5                       | Yes<br>(1 telephonic not recorded) |
| Co-founder & Chief Operating Officer (COO) | 1                    | 1                         | No                                 |
| Manager (Marketing & Strategy)             | 3<br>(2 telephonic)  | 5                         | Yes<br>(1 telephonic not recorded) |
| Category Manager                           | 1                    | 2.5                       | Yes                                |
| Tech Lead                                  | 1                    | 1.5                       | Yes                                |

**Table 2. Detail of interviews at OMEGA**

Interviews with OMEGA's personnel revealed that they often referred to a plethora of official blogs, articles, and online help pages to better understand the possibilities offered by social media. In the spirit of ANT, we accessed these materially inscribed publicly available digital artifacts, over the Internet. While providing an exhaustive list of online resources used is not possible due to space constraints, an indicative list of these resources is presented in Table 3.

| Webpage / Blog                             | URL  | Content Description  |
|--|--|--|
| Facebook for Business                      | <a href="http://www.facebook.com/business/">www.facebook.com/business/</a>     | Latest news, tips & best practices for businesses who use Facebook     |
| Facebook Newsroom                          | <a href="http://newsroom.fb.com/">newsroom.fb.com/</a>                         | Information and news about Facebook, its products, its investors, etc. |
| Facebook for Developers                    | <a href="http://developers.facebook.com/blog">developers.facebook.com/blog</a> | Product documentation, tools and support for Facebook's APIs           |
| Facebook Help Center                       | <a href="http://www.facebook.com/help/">www.facebook.com/help/</a>             | Support for individual and commercial Facebook users                   |
| Jon Loomer for Advanced Facebook Marketers | <a href="http://www.jonloomer.com/">www.jonloomer.com/</a>                     | Marketing tactics for Facebook   |
| TechCrunch                                 | <a href="http://techcrunch.com/">techcrunch.com/</a>                           | Technology industry news   |

**Table 3. Indicative list of web resources**

### Analysis

As our fieldwork proceeded in following one actor after another, we consciously started tracing the interrelationships between different actors. Soon, we realized that majority of the narratives clustered

around particular technologies, such as the web portal, electronic marketplaces, search facility, analytics software, social media, etc. In this paper we present our findings related mainly to the social media practices at OMEGA. While, OMEGA used social media for varied purposes including advertising, community building, and marketing communication, we restrict ourselves to its advertising practices here.

We started off with the preconception that social media as a technology would afford, that is, allow and forbid, certain actions to its users (Akrich and Latour 1992). However, in building the actor-network, we understood that what we had black boxed (Latour 1987) as ‘social media,’ was constituted of the actors that we were following. We, therefore, decided to open this black box of ‘social media’ to unravel nuances about organizational practices. This helped us in foregrounding the interactions and interrelationships among heterogeneous actors, including individual Facebook users, personnel at OMEGA, OMEGA’s competitors, Facebook Inc., computational algorithms, and the like. Digital artifacts such as blogs, reports, and articles from the Internet allowed us to ‘bracket away’ (Law 1986) Facebook’s managers, technologists, and material technology. Instead we dealt with mobile and durable inscriptions that spoke on their behalf (Callon 1986), and additionally rendered the material and algorithmic agents less ‘inscrutable’ (Orlikowski and Scott 2015).

In tracing the actor-network, we encountered two different types of Facebook users; the first being business users, such as marketers and advertisers, who typically used Facebook for the purpose of business, and the second being individual users who typically used Facebook for socialization and interaction with other individual and business users. Facebook ads and summary/statistical reports circulated in the form of inscriptions in the network (Callon and Law 2004). These inscriptions ‘bracketed away’ individual users and their locally expressed behavior, and allowed marketers at OMEGA to instead deal with mobile and traceable inscriptions (Law 1986). By circulating in the network, these inscriptions allowed advertisers to act on Facebook users at a distance and be influenced by their distant actions (Latour 1987). This observation instigated us to impose the theoretical categories of cycles of accumulation and centers of calculation (Latour 1987) to understand the unfolding of OMEGA’s advertising practices on Facebook. We, therefore, set out to identify the centers, follow the circulations of extraordinary means across the actor-network as they rendered the distant mobile and combinable, and examine the results of eventual calculations performed on the accumulations in the centers. Based on this exercise, we present our findings as three affordances that we have coded as *reachability*, *engageability*, and *targetability*.

## Findings

OMEGA’s advertising practices on Facebook aim at presenting the qualities and characteristics of their products to an audience that might get interested in its offerings, and purchase the same on OMEGA’s website. Therefore, for each ad that the marketing team of OMEGA creates on Facebook, it must, first, identify the potentially interested audience; second, show the ad to this audience; and third, get this audience interested in the ad. We show that affordances pertaining to each of these activities are actualized through a complicated interplay of interactions. However, for the sake of comprehensibility, we do not present the findings in the order of activities mentioned above. We begin with discussing the affordance pertaining to the second activity of showing ads to an audience. This is followed by delineating the affordance relating to the third activity of getting the audience interested in the ads. Finally, we present the affordance related to the first activity of identifying interested audiences.

### ***Reachability: Inscriptions going away to distant people***

Our data shows that OMEGA’s confidence in using social media for advertising lies in the possibility to non-obtrusively reach out to thousands of people who are interested in its offerings. But, such audience is spatially and temporally distributed across the social network. Therefore, Facebook provides features using which the marketers can create ads that are subsequently served in the News Feed of these potentially interested users. The process of creating an ad on Facebook involves multiple proximal invocations of the material agency of Facebook (Leonardi 2012). It starts from defining the



characteristics<sup>1</sup> of Facebook users who are likely to be interested in OMEGA's products, and ends at setting a budget for the ad.

*[An ad] shows to those we set as the target. A [potential] reach is shown for each [ad]. If I make an ad and choose a target audience 'A' with some demographics, geography and interests, so, I target them. Let's say the size of the audience is 100, which is computed by Facebook based on who falls in that group. So it tells the audience size. Then you set a budget and Facebook tells you that out of these people what is the daily reach potential. If you want to reach all 100, then increase budget. If the budget is sufficient you will reach all.*

As represented in the above quote, the multiple proximal invocations of Facebook's material agency result in the computation of the potential daily reach of the ad. This is the number of people on Facebook who are likely to see the ad in their News Feed, given the budget. However, once the marketer finishes the creation of the ad, the ad is not pushed to all Facebook users who fulfill the defined characteristics. OMEGA has to first specify its objective for the ad, that is, the result it expects the ad to deliver, before the ad starts displaying in the News Feed of users.

*For every campaign you have to choose an objective – it can be cost per conversion, it can be to boost conversion on your website, send people to your website, boost your posts [for] engagement, boost app installs, etc. There are 8-10 objectives which Facebook provides and we choose an objective for a campaign when we create it.*

The objective set by OMEGA allows Facebook to decide whom to deliver the ad to. Here, Facebook's algorithmic agency plays a crucial role by deciding who among Facebook's 1.5 billion users is most likely to perform the desired action on the ad. The reactions of users on the ad get inscribed in the form of 'clicks', 'likes', 'comments', etc. on the ad itself. As will become clear later, Facebook is able to accumulate this information about the reactions of users on all the ads created by the two million advertisers<sup>2</sup> who use Facebook for advertising. This accumulated information allows Facebook to act as a center of calculation (Latour 1987), where Facebook's algorithms learn and calculate whom to subsequently send OMEGA's ad to. This is also reflected in an excerpt from an article by the Engineering Manager of News Feed Ads at Facebook<sup>3</sup>:

*Every time someone visits News Feed, we choose between thousands of ads to determine the best ones to show...Marketers tell us which people they think will be interested in their ad...Marketers also tell us how much they are willing to pay to show an ad...People also tell us what types of ads they want to see and don't want to see. When a person interacts with an ad (clicks, likes, comments on, or shares), News Feed learns that these ads are relevant for them. When someone hides an ad, News Feed learns that that person wants to see less of those types of ads.*

In this way, based on the collectively enacted diverse agencies (Çalışkan and Callon 2010) of marketers at OMEGA, Facebook's algorithms and Facebook users, OMEGA's ad becomes a mobile inscription. The inscription *goes away* from OMEGA to reach interested audiences who are distanced in space and time across the social network (Latour 1987). We define this ability of an advertiser to reach a potentially interested but distant user by having its ad displayed to the user as *reachability*. To reiterate, reachability is not simply actualized when a human agent invokes material agency on Facebook to create an ad. Rather, it requires Facebook's algorithms to also enact their own agency, based on continuous learning from the agency being enacted by individual Facebook users.

### ***Engageability: Inscriptions crossing people's paths***

Out of the various ad placements provided by Facebook, marketers at OMEGA usually choose to have ads displayed in the News Feed of users. These ads appear in the News Feed of a user, alongside other stories from friends of the user. However, marketers at OMEGA understand that Facebook is not a place where

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<sup>1</sup> See the sub-section on Targetability for more details

<sup>2</sup> See (Facebook.com 2015)

<sup>3</sup> See (Hong Ge 2013)

users come to view ads. As a result, their ads need to engage an interested user just like any other Facebook story that s/he receives from her/his friends.

*On social media users engage with each other, they are there to socialize, to check other people's updates... On Facebook, our goal is [also] to engage with the users. It's a place where customers and others can interact with us.*

When OMEGA's ad reaches interested audiences, they may use the features made available by the materiality of the ad, such as, 'like', 'share', 'comment', 'shop now', and 'like page' buttons. In so doing, they actualize the proximal affordance of *association* (Treem and Leonardi 2012) and engage with the ad. A user may apprehend one or more of these features depending on her/his intention. Once a button is pressed, Facebook's material agency (Leonardi 2012) gets activated and inscribes the user's action on the ad itself. For example, when a user clicks on the 'like' button on an ad, her/his liking for the ad gets recorded as a link to her/his Facebook profile in a list of links to Facebook profiles of other users who 'liked' the ad. In this way, inscribed information about distant users' actions on distantly produced ads is brought back and accumulated by Facebook (Latour 1987). Facebook's algorithmic agency continuously calculates the performance of the ad on the basis of this accumulation of reactions of *all* individual users on that ad. It then compared the performance of this ad with that of *all* the ads being run by *all* the business users on the platform. Additionally, accounting for the bid set for this ad by OMEGA, the algorithmic agency decides whether to continue serving the ad, or to stop serving it. This is illustrated in the following description from Facebook for Business<sup>4</sup>:

*For each ad impression, our ad auction system selects the best ads to run based on the ads' maximum bids and ad performance. All ads on Facebook compete against each other in this process, and the ads that our system determines are most likely to be successful will win the auction.*

Aggregation and calculations upon inscribed users' actions produce another set of higher-order inscriptions, which are made available to OMEGA in the form of summary reports. Table 4 presents an illustrative snippet of one such report for three ads being run simultaneously on Facebook by OMEGA. For each ad, 'CTR' represents the click-through rate (that is, the percentage of times a user clicks on the ad when the ad is shown in her/his News Feed), 'Clicks' represents the number of times a user associated with the ad, 'Reach' represents the number of Facebook users who received the ad, 'Frequency' represents the number of times an ad was shown to a user, 'Impressions' represents the total number of times the ad was shown, and 'Amount Spent' represents the amount paid by OMEGA to Facebook for having users perform a desired action.

| <b>Id</b> | <b>CTR</b> | <b>Clicks</b> | <b>Reach</b> | <b>Frequency</b> | <b>Impressions</b> | <b>Amount Spent (INR)</b> |
|-----------|------------|---------------|--------------|------------------|--------------------|---------------------------|
| 1         | 0.572519   | 3             | 521          | 1.005758         | 524                | 12.27                     |
| 2         | 0.919794   | 75            | 7836         | 1.040582         | 8154               | 600.6                     |
| 3         | 1.204819   | 339           | 27291        | 1.030999         | 28137              | 2861.85                   |

**Table 4. Report on ad performance**

Through these higher-order inscriptions OMEGA's marketers are also able to assess the performance of their ads and learn what may work in future. For example, marketers at OMEGA are able to understand that only those ads with which users engage continue to be served, that is the ads that have a high CTR continue to get served. The ads that do not perform well, by not engaging users, stop being served. Therefore, only ads that generate engagement continue to be served; and it is only these ads that can solicit engagement in future.

*Now the performance metrics for ads is click-through rate or CTR. If I run 3 ads for the same audience, then the ad which brings in the best CTR is the one which sustains for the longest period. The ad which does not receive CTR is not served by Facebook... So Facebook itself wants ads with higher interaction to be served.*

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<sup>4</sup> See (Facebook.com 2016)

To summarize, owing to the agency exercised by Facebook's algorithms, an ad is served to interested audiences who are distanced in space and time (Latour 1987). These users may subsequently invoke the proximal affordance of *association* (Treem and Leonardi 2012) by interacting with the materiality (buttons, links, etc.) of the ad. If more and more users continually engage with the ad, it continues to be served to users' News Feeds by Facebook. In this way, the collectively enacted diverse agencies (Çalışkan and Callon 2010) of the users, Facebook's materiality, and Facebook's algorithms, enable OMEGA to engage with distant users by having its ad *cross the paths* (Latour 1987) of these users. We define this ability of an advertiser to engage with potentially interested but distant users through its ad as *engageability*. We observe that the initial actualization of the affordance of engageability by an advertiser requires her/him to first actualize the affordance of reachability, followed by users who receive the ad clicking on it. Moreover, the subsequent reachability (and engageability) afforded to an advertiser is also conditional upon the prior actualization of the affordance of engageability by the advertiser. This is because Facebook continues to serve only those ads that are able to engage the users they were served to.

### ***Targetability: Inscriptions coming back with information about distant people***

The primary reason for OMEGA to use Facebook for advertising is that it caters to a very specific audience, which cannot be harnessed using other media. Since, the characteristics of its potential customers match with those of users on Facebook, OMEGA reposes all its efforts on Facebook.

*Our product is more of a youth oriented product, it's a fashion accessory, it's based on interests – depending on whether the user is interested in football or music and so on. It's a fashion statement. The crowd for this category is available on social media platforms. They have accounts on Facebook. The youth socializes on Facebook.*

It is clear by now that advertising on Facebook is a challenge. OMEGA must first, through its ad, reach those Facebook users who will be interested in its offerings. Users' engagement with the ad will then allow further circulation of the ad, so that OMEGA can reach more users. However, even before the ad can be sent away to Facebook users, OMEGA must define a set of characteristics that are likely to be possessed by those potentially interested in its offerings.

*Facebook is a display advertising medium with very powerful targeting options. It gives us the demographics of the people. It gives us their interests. It tells us what phone they have... where they live... what are their activities... are they engaged, married, or single... are they college goers or graduates... Facebook gives all the details and on the basis of that we target.*

Once an ad's tentative target audience receives the ad, they may start associating with the ad. These associations, as already explained, get inscribed on the ad itself. As the ad circulates on the social network, Facebook starts accumulating this inscribed information about each and every action performed by interested users on the ad. As more and more information is gathered, a cycle of accumulation sets into motion with Facebook as its center. Algorithmic agents start summarizing and aggregating (Latour 1987) the accumulated information into another set of higher-order inscriptions. These are then made available to OMEGA in the form of statistics about actions and preferences of Facebook users. From the reports that we collected from OMEGA, we found that Facebook makes statistics available on 227 parameters for each ad created. We have categorized these parameters under 5 heads. Table 5 presents these categories along with a description of the category, the number of parameters out of the 227 parameters under each category, and illustrative examples of parameters reported for each category.

| Category       | Description  | Number of parameters | Illustrative examples   |
|----------------|--|----------------------|---|
| Identification | Identifiers of the ad                                  | 8                    | Ad Name, Ad ID, Ad Set Name   |
| Action         | Information on what actions users have taken on the ad | 84                   | Clicks (All), Page Likes, Post Engagement, Post Shares, Post Comments, Post Likes |
| Performance    | Information on how the ad is performing                | 18                   | CTR (All), Reach, Frequency, Impressions  |
| Economics      | Information on costs incurred                          | 112                  | Amount Spent, CPC (All), Cost per All Actions, CPM (Cost per 1,000 Impressions)   |
| Miscellaneous  | Information specific to the report, ad status, etc.    | 5                    | Reporting Starts, Reporting Ends, Delivery  |

**Table 5. Parameters reported by Facebook**

In this way, statistical reports *come back*, bringing with them information about the actions of Facebook users who associate with the ads, but, are distanced in space and time (Latour 1987). Marketers at OMEGA judge whether the audience to which the ad was targeted is interested in OMEGA’s offerings from the values for various parameters reported for each ad. They are also able to use this information to profile people/users who seem to be engaging with their posts. In this way, OMEGA also becomes a center of calculation (Callon and Muniesa 2005), performing calculations on digital statistical reports containing information aggregated by Facebook about distant users’ actions. These calculations enable it to identify who among the millions of distant users available on Facebook are likely to be interested in its ads, so that it can fine-tune the targeting of future ads.

We define the ability of an advertiser to identify characteristics of potentially interested but distant users who can be targeted with an ad as *targetability*. Furthermore, in this case as well, we observe that the actualization of the affordance of targetability by an advertiser is contingent upon the collective enactment of diverse agencies of users, marketers, and algorithms. Further, targetability requires the actualization of the affordances of reachability and engageability, along with the proximal affordance of association (Treem and Leonardi 2012).

***Putting it together: Affordances actualized through agencements***

The intent of OMEGA’s advertising on Facebook is to *target* an audience which is interested in its offerings, *reach* out to this audience through its ads, and ensure that the ads fulfill their objective by keeping the audience *engaged*. However, this audience is distanced in space and time from OMEGA. Nonetheless, OMEGA is able to bridge this distance by taking advantage of Facebook’s algorithmic agency, which has the capability to be invoked at a distance and to act at a distance. The collective enactment of diverse human, algorithmic, and material agencies results in the actualization of complex affordances, namely targetability, reachability, and engageability. The actualization of these complex affordances is depicted in Figure 1 and explained below.

In order to understand the actualization of affordances, let us assume that an ‘Ad’ has been served in the News Feed of a user on Facebook (arrow 1). This user may actualize the proximal affordance of association (Treem and Leonardi 2012) by performing actions on the ‘Ad’. In reality, there are millions of ads created by millions of advertisers being served to billions of Facebook users, who might be associating with the ads. We represent these associations (dotted two-sided arrows) as relationship between human agency of Facebook users (blue circles) and the materiality of the ads (green triangles) that these users are exposed to on Facebook. Subsequently, the ad returns to Facebook from these distant users’, bringing back users’ associations (arrow 2) in the form of their inscribed actions on it. This is depicted in Figure 1 as an ‘Ad with inscribed user information.’ Facebook accumulates all such ads which return with inscribed user information, and a cycle of accumulation (Latour 1987) is established with Facebook as its center. That is, ads are first sent to the News Feed of potentially interested users (arrow 1), and then these ads come back with information on distant users’ actions (arrow 2). Thereafter, Facebook’s algorithms calculate upon and summarize this information (Latour 1987) gathered from the actions of distant users on various ads. In this way, Facebook becomes a center of accumulation and calculation (black circle labeled Facebook). The calculations performed in this center are represented as proximal interactions between materiality of the ads and Facebook’s algorithmic agency (dashed blue lines). Based on these calculations, if the ‘Ad’ is construed as performing well, it is served to more and more Facebook users likely to be interested in it (arrow 1). Some results of such calculations are made available in the form of

material artifacts, that is ‘Statistics’ (orange triangle), to advertisers (arrow 3). An advertiser, typically, accumulates this information, and uses it to calculate whom to choose as targets before posting its subsequent ads (arrow 4). Hence, the advertiser also constitutes another center of accumulation and calculation (black circle labeled Firm). The calculations performed are depicted as proximal interactions (dashed blue lines) between the human agency of advertisers at the firm and the materiality of Facebook (ads and statistics) exposed to them. A cycle of accumulation is also established with the firm as its center, such that ads targeted to a potentially interested distant audience are posted by the advertiser, and statistical reports about the response of this audience to those ads are returned.

Therefore, based on the calculation performed at the firm, as well as Facebook, an ‘Ad’ goes away to distant audiences (arrows 4 and 1), leading to actualization of the affordance of *reachability*. For the ad to stay in circulation, the distant audience served the ad must proximally associate with it, and their inscribed actions must return to Facebook. If the ad is not responded to, it does not return with any additional information in the form of users’ inscribed actions. In such a scenario, Facebook’s algorithms eventually stop serving the ad, making it disappear without any trace (Latour 1987). Therefore, by having the ad *cross the paths* of an interested audience (arrows 1 and 2), and having them respond to its content, the firm is able to actualize the affordance of *engageability*. Furthermore, as the ad *comes back* with more and more information about the responses of the audience it is served to (arrows 2 and 3), the firm is able to actualize the affordance of *targetability*. In this way, advertisers actualize the complex affordances of *targetability*, *reachability*, and *engageability* on Facebook.

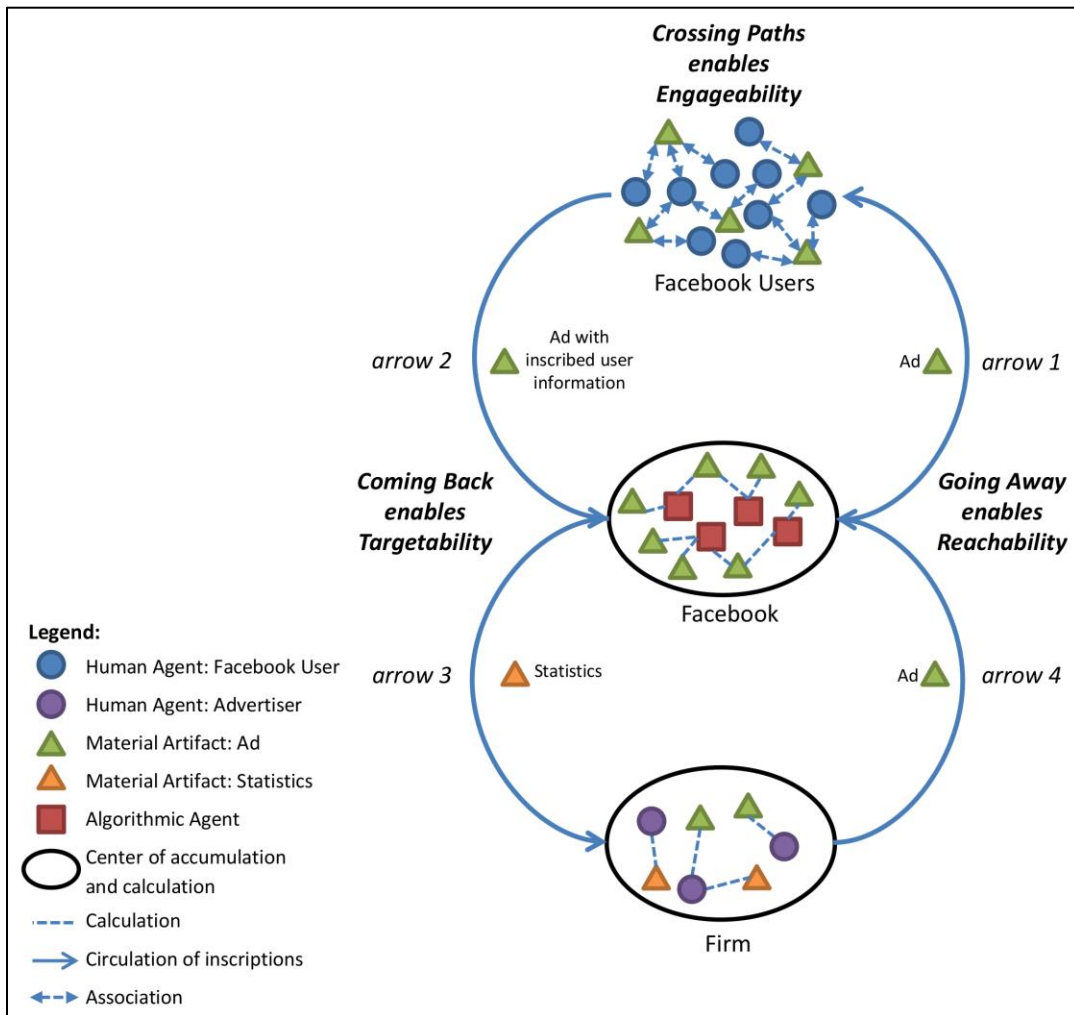


Figure 1. Affordances actualized through agencement

The above explication implies that complex affordances, such as targetability, reachability, and engageability identified in this paper are related to each other, and may sometimes also involve the realization of proximal affordances. To illustrate this, let us recall the details presented in Table 4, where the three ads are part of the same ad set, meaning that a common budget, objective, and target are defined for all three ads. The table illustrates that the actualization of the affordance of reachability (reach column) by the advertiser is subject to the actualization of the proximal affordance of association (clicks column) by the user who receives the ad in her/his News Feed. We observe that as the reach for ad number 3 is more than that of ad number 1, so are the clicks. In other words, the more an advertiser is able to reach a distant user's News Feed with her/his ad, the more likely is the user to get associated with the ad. Furthermore, the actualization of the affordance of engageability by an advertiser is also subject to the actualization of the proximal affordance of association by a Facebook user who receives the ad. The more that an ad is clicked on (clicks column) by the users, each time it appears in their News Feed (impressions column), the more engaging it is (CTR column) from the perspective of the advertiser. In turn, the actualization of the affordance of engageability by the advertiser implies better performance, as calculated by Facebook's algorithmic agency, which instigates Facebook's algorithms to continue serving the ad, leading to higher reach of the advertiser's ad. This point is also reflected in the e-mail communication from a marketer who shared the report depicted in Table 4:

*You'll notice that these ads have a common ad set but the ad with better click through rate is consuming higher budget. Facebook gives preference to engaging content.*

In actualizing the above complex affordances, diverse heterogeneous agents – human, material, and algorithmic – come together to collectively enact, what Callon (2007) calls a socio-technical *agencement*. Agencement signifies arrangements endowed with the capacity of acting in different ways depending on their configuration. We prefer the use of this term, since in our case if any of the diverse agents behave otherwise the affordance is not actualized or actualized differently. For example, if users don't associate with ads, or the calculative logic embedded in Facebook's algorithms undergoes a change, or Facebook stops accumulating and making users' characteristics available to advertisers, or the materiality of Facebook exposed to the user alters, then these affordances might not come into existence. Since, the agency enacted by each agent is relational to the agency of other agents comprising the agencement, it is only when a suitable configuration of all the agents involved is achieved for a particular ad, that the agencement of the affordance is actualized. For example, when a marketer at OMEGA prepares an ad for a particular audience, and the ad gets served in the News Feed of a particular individual belonging to this audience, the affordance of reachability is actualized only through the collectively enacted agency of an arrangement of the marketer, OMEGA's ad, Facebook's materiality, Facebook's algorithms, and the user who receives the ad. Once this agencement is actualized, it persists in the form of the ad that now appears in the News Feed of the user. However, when this ad has to be served to another Facebook user, the agencement will have to be actualized afresh for the affordance to be actualized.

## **Discussion**

Recent research in the field of Information Systems has explored the salience of material agency of technology. This material agency is activated when humans approach the technology with a particular intention and decide which elements of the technology's materiality to use at a given time (Leonardi 2012). Such a conceptualization assumes the need for proximal invocation of material agency by human agency (Demir 2015). However, our research shows that in the context of social media, in addition to the material agency of the social media technology, its algorithms also enact their agency. These algorithms do not require proximal instigation to act, and run continuously in the backdrop of the technology exercising, what Graham (2005) refers to as, 'continuous agency'. In the presence of algorithmic agents, goal-oriented action by a human agent is not subject merely to the actualization of 'proximal affordances' that require proximal invocation of the material agency of the technology. For example, we show that the actualization of the affordance of reachability by an advertiser is not dependent on the mere invocation of Facebook's materiality by her/him. Rather, it involves an agencement (Callon 2007) of disparate human (business users and individual users), material (ads, statistics, buttons), and algorithmic agents collectively enacting their diverse agencies (Çalışkan and Callon 2010). The affordances actualized through the enactment of an agencement are more complex, giving rise to what we call 'complex affordances.' The complexity arises on account of actions by algorithmic agents, along with the

actualization of proximal affordances identified in literature, such as association (Treem and Leonardi 2012). In this way, the proximal affordances assist in the actualization of these complex affordances by human agents. Furthermore, this interplay of material and algorithmic agents allows human agents to undertake actions at a distance (Latour 1987). For example, after an advertiser creates an ad by invoking Facebook's material agency, s/he is afforded the ability to have the ad displayed in the News Feed of targeted distant users without actualizing any other proximal affordance.

Algorithmic agency differs from material agency in its 'labyrinthine components, processes, and opacity, and the subjective nature of the decisions reached' (Tufekci 2015). A more important difference lies in the ability of algorithmic agents to aggregate the dispersed opinions of the 'crowd' of users on a platform and act in response to this aggregation (Striphas 2015). Even though the logic for exercise of agency is encoded into the technology, algorithmic agency is also designed to be 'communally' informed by the entire user base of the technology (Beer 2009). This in-built logic to learn from the actions of the user base renders the algorithms running in the backdrop of social media platforms 'inscrutable'. Hence, only part of the 'inscrutability' of the algorithms can be explained through their logic being kept secret owing to competitive reasons and to prevent users from gaming the systems (Orlikowski and Scott 2015). Since, algorithmic agency is sensitive to the actions of the crowd of users, the consequences of this agency are emergent. "Boundaries and affordances react and reorganize themselves around the users' engagements" (Beer 2009), such that, often the designers of these algorithms too cannot predict the algorithms actions. Extant research has either investigated contexts devoid of such communally informed algorithmic agency (See, for example, Hultin and Mähring 2014; Introna and Hayes 2011; Leonardi 2011), or has investigated contexts with algorithmic agency, without theoretically dealing with such agency (See, for example, Hallerbach et al. 2013; Zheng and Yu 2014). By foregrounding algorithmic agency of complex technologies, this research aims to contribute towards a richer understanding of technological affordances in such scenarios.

Using ANT as method we were able to overcome the inability of other techniques, such as ethnography and grounded theory, to focus on the role of algorithms running in the backdrop of complex technologies. Since, ANT confers agency both to humans and non-humans (Latour 1990), we were able to trace the influence of algorithmic agents on every experience and action of users on these technology platforms, and vice versa. Not only does ANT enable us to empirically establish the relationality among human, material, and algorithmic agency, but it also provides us with the language to understand the collective enactment of heterogeneous agents dispersed across space and time (Çalışkan and Callon 2010; Latour 1987). Furthermore, by following heterogeneous actors (Latour 2005) as they collectively enact their agency, we were able to enliven algorithms and activate their consequences (Orlikowski and Scott 2015).

## Conclusion

In this paper, we highlight the role played by algorithmic agents, in addition to material and social agents, in actualization of technology affordances in complex sociotechnical contexts. We contribute to the developing body of literature on technology affordances in three ways. Firstly, we explicate that in such scenarios, *complex* affordances are actualized when an agencement (Callon 2007) of heterogeneous material, algorithmic and human agents (themselves socially heterogeneous) is actualized. Secondly, we show that algorithmic agency involved in the actualization of complex affordances allows human agents to carry out goal-oriented action *at a distance* (Latour 1987). Thirdly, we contribute methodologically by illustrating the advantage of ANT to study complex technological phenomena involving action at a distance, since, it allows algorithmic agents to become less inscrutable (cf. Orlikowski and Scott 2015). We also contribute to practice by highlighting that the actualization of affordances in complex technological scenarios, such as social media or online platform, are not determined merely by what affordances are designed into the user interface by its designers (Norman 1988). Rather, the actualization of affordances is governed by the agency exercised by the technology's materiality and algorithms, in addition to the human agency exercised by numerous users distanced in space and time. What the algorithms running in the backdrop of these technologies are coded to do, what information about users is accumulated, and how this information is used, significantly influence what these technologies afford. We consider this research to be a first step towards development of concepts and theories aimed at understanding complex affordances, and hope that it will instigate further research to better understand contexts where such affordances actualize.

## References

- Akrich, M., and Latour, B. 1992. "A Summary of a Convenient Vocabulary for the Semiotics of Human and Nonhuman Assemblies," in *Shaping Technology/ Building Society: Studies in Sociotechnical Change*, W. E. Bijker and J. Law (eds.), The MIT Press, pp. 259–264.
- Andersen, J. V., Lindberg, A., Lindgren, R., and Selander, L. 2016. "Algorithmic Agency in Information Systems: Research Opportunities for Data Analytics of Digital Traces," in *49th Hawaii International Conference on System Sciences*, pp. 4597–4605.
- Beer, D. 2009. "Power through the algorithm? Participatory web cultures and the technological unconscious," *New Media & Society* (11:6), pp. 985–1002.
- Bloomfield, B. P., Latham, Y., and Vurdubakis, T. 2010. "When is an Affordance? Bodies, Technologies and Action Possibilities," *Sociology* (44:3), pp. 415–433.
- Çalışkan, K., and Callon, M. 2010. "Economization, part 2: a research programme for the study of markets," *Economy and Society* (39:1), pp. 1–32.
- Callon, M. 1986. "Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay," in *Power, action and belief: a new sociology of knowledge?*, J. Law (ed.), Routledge, pp. 196–223.
- Callon, M. 2007. "What does it mean to say that economics is performative?," in *Do Economists Make Markets? On the Performativity of Economics*, D. MacKenzie, F. Muniesa, and L. Siu (eds.), Princeton University Press, pp. 311–357.
- Callon, M., and Latour, B. 1992. "Don't throw the baby out with the bath school! A reply to Collins and Yearley," in *Science as practice and culture*, A. Pickering (ed.), The University of Chicago Press, pp. 343–368.
- Callon, M., and Muniesa, F. 2005. "Economic Markets as Calculative Collective Devices," *Organization Studies* (26:8), pp. 1229–1250.
- Collins, H. M., and Yearley, S. 1992. "Epistemological Chicken," in *Science as practice and culture*, A. Pickering (ed.), The University of Chicago Press, pp. 301–326.
- Demir, R. 2015. "Strategic Activity as Bundled Affordances," *British Journal of Management* (26:S1), pp. S125–S141.
- EMarketer.com. 2014. "Majority to Use Mobile Phones in India Next Year," (available at <http://www.emarketer.com/Article/Majority-Use-Mobile-Phones-India-Next-Year/1011780>; retrieved April 27, 2016).
- Facebook.com. 2015. "Thank You," *Facebook for business* (available at <http://www.facebook.com/business/news/two-million-advertisers>; retrieved January 25, 2016).
- Facebook.com. 2016. "Ad Auction," *Facebook for business* (available at <http://www.facebook.com/business/help/163066663757985>; retrieved August 24, 2016).
- Gibson, J. J. 1986. "The Ecological Approach To Visual Perception," Psychology Press.
- Graham, S. D. N. 2005. "Software-sorted geographies," *Progress in Human Geography* (29:5), pp. 562–580.
- Hallerbach, I. P., Barrett, M., and Faraj, S. 2013. "Emergence in Nascent Online Communities: An Affordance Perspective," in *Thirty Fourth International Conference on Information Systems*, pp. 1–12.
- Hong Ge. 2013. "News Feed FYI: More Relevant Ads in News Feed," *Facebook Newsroom* (available at <http://newsroom.fb.com/news/2013/09/news-feed-fyi-more-relevant-ads-in-news-feed/>; retrieved April 14, 2016).
- Hultin, L., and Mähring, M. 2014. "Visualizing institutional logics in sociomaterial practices," *Information and Organization* (24:3), pp. 129–155.
- Hutchby, I. 2001. "Technologies, Texts and Affordances," *Sociology* (35:2), pp. 441–456.
- Introna, L. D., and Hayes, N. 2011. "On sociomaterial imbrications: What plagiarism detection systems reveal and why it matters," *Information and Organization* (21:2), pp. 107–122.
- Jarrahi, M. H., and Sawyer, S. 2013. "Social Technologies, Informal Knowledge Practices, and the Enterprise," *Journal of Organizational Computing and Electronic Commerce* (23:1).
- Kallinikos, J. 2012. "Form, Function, and Matter: Crossing the Border of Materiality," in *Materiality and Organizing: Social Interaction in a Technological World*, P. M. Leonardi, B. A. Nardi, and J. Kallinikos (eds.), Oxford University Press, pp. 67–87.
- Latour, B. 1987. *Science in action: How to follow scientists and engineers through society*, Harvard



- University Press.
- Latour, B. 1990. "Technology is society made durable," *The Sociological Review* (38:S1), pp. 103–131.
- Latour, B. 2004. "On using ANT for studying information systems: a (somewhat) Socratic dialogue," *The social study of information and communication technology*, pp. 62–76.
- Latour, B. 2005. *Reassembling the Social: An Introduction to Actor-Network Theory*, Oxford University Press.
- Law, J. 1986. "On power and its tactics: a view from the sociology of science," *The Sociological Review* (34:1), pp. 1–38.
- Leonardi, P. M. 2008. "Organizing Technology: Toward a theory of sociomaterial imbrication," in *Academy of Management Proceedings*, Academy of Management, pp. 1–6.
- Leonardi, P. M. 2011. "When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies," *MIS quarterly* (35:1), pp. 147–167.
- Leonardi, P. M. 2012. "Materiality, Sociomateriality and Socio-Technical Systems: What do these terms mean? How are they different? Do we need them?," in *Materiality and Organizing: Social Interaction in a Technological World*, P. M. Leonardi, B. A. Nardi, and J. Kallinilos (eds.), Oxford University Press, pp. 25–45.
- Majchrzak, A., Faraj, S., Kane, G. C., and Azad, B. 2013. "The Contradictory Influence of Social Media Affordances on Online Communal Knowledge Sharing," *Journal of Computer-Mediated Communication* (19:1), pp. 38–55.
- Majchrzak, A., Wagner, C., and Yates, D. 2013. "The Impact Of Shaping On Knowledge Reuse For Organizational Improvement With Wikis," *MIS Quarterly* (37:2), pp. 455–469.
- Markus, M. L., and Silver, M. S. 2008. "A Foundation for the Study of IT Effects: A New Look at DeSanctis and Poole's Concepts of Structural Features and Spirit," *Journal of the Association for Information Systems* (9:10/11), pp. 609–632.
- Martini, A., Massa, S., and Testa, S. 2013. "The firm, the platform and the customer: A 'double mangle' interpretation of social media for innovation," *Information and Organization* (23:3), pp. 198–213.
- McLean, C., and Hassard, J. 2004. "Symmetrical absence/symmetrical absurdity: Critical notes on the production of actor-network accounts," *Journal of Management Studies* (41:3), pp. 493–519.
- Miles, M. B., and Huberman, A. M. 1994. *An Expanded Sourcebook: Qualitative Data Analysis* (2nd ed.), Sage Publications.
- Norman, D. A. 1988. *The Psychology of Everyday Things*, Basic Books.
- Norman, D. A. 2013. *The design of everyday things: Revised and expanded edition*, Basic Books.
- Orlikowski, W. J., and Barley, S. R. 2001. "Technology and institutions: what can research on information technology and research on organizations learn from each other?," *MIS Quarterly* (25:2), pp. 145–165.
- Orlikowski, W. J., and Scott, S. V. 2015. "The Algorithm and the Crowd: Considering the Materiality of Service Innovation," *MIS Quarterly* (39:1), pp. 201–216.
- Striphas, T. 2015. "Algorithmic Culture," *European Journal of Culture Studies* (18:4–5), pp. 395–412.
- Treem, J. W., and Leonardi, P. M. 2012. "Social Media Use in Organizations: Exploring the Affordances of Visibility, Editability, Persistence, and Association," *Communication Yearbook* (36), pp. 143–189.
- Tufekci, Z. 2015. "Algorithmic Harms beyond Facebook and Google: Emergent Challenges of Computational Agency," *Journal on Telecommunications & High Tech Law* (13:23), pp. 203–216.
- Walsham, G. 1997. "Actor-Network Theory and IS Research: Current Status and Future Prospects," in *Information Systems and Qualitative Research: Proceedings of the IFIP TC8 WG 8.2*, A. S. Lee, J. Liebenau, and J. I. DeGross (eds.), Springer Science+Business Media, pp. 466–480.
- Walsham, G., and Sahay, S. 1999. "GIS for district-level administration in India: problems and opportunities," *MIS quarterly* (23:1), pp. 39–65.
- Zammuto, R. F., Griffith, T. L., Majchrzak, A., Dougherty, D. J., and Faraj, S. 2007. "Information Technology and the Changing Fabric of Organization," *Organization Science* (18:5), pp. 749–762.
- Zheng, Y., and Yu, A. 2014. "Social Media, Institutional Innovation and Affordances: The Case of Free Lunch for Children in China," in *Thirty Fifth International Conference on Information Systems*, Auckland.