



IT Signal Generation and Management Capabilities' Effect on Corporate Reputation: A Typological Approach to Strategic Positioning in a Digital World

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Abstract

In this paper, we explore how signal generation capabilities (SGCs) and signal management capabilities (SMCs) affect corporate reputation management strategies, with respect to modern technologies of the digital world. Expanding upon signaling theory, and the notion of informational asymmetries, we draw attention to the complementary roles of current IT in creating and managing signals of productive and qualitative efficiency that may be converted into corporate reputation. We introduce a new typological classification for firms' strategic positioning that highlights how technologies lead firms to be *signal amplifiers*, *signal squanderers*, *signal mollifiers*, and *signal diminishers* with respect to reputation management. We discuss the theoretical contributions and practical implications of our research, alongside ethical and methodological considerations that could spawn interesting avenues of future research.

Keywords Corporate reputation · Signaling theory · IT investments · Signal generation capabilities · Signal management capabilities

Introduction

Technological advancements have opened new communication channels that facilitate massive amounts of information sharing and evolved to include interpersonal online and user-generated communication platforms like social media, or what is commonly referred to as Web 2.0 technologies (Baka 2016; Leek et al. 2016; Toplu et al. 2014). These new technologies have affected the way firms manage their reputation and how information about their 'brand' is controlled (Gensler et al. 2013; Kuksov et al. 2013; Park and Kim 2014) and may require organizational restructuring and new reputation management practices to keep pace with the

digital society. Managers are no longer the sole authors of their companies' reputation and in control of its perceived value, instead, new technologies have allowed for the co-creation of value by firms and groups of consumers (Prahalad and Ramaswamy 2004). More than ever, the "management of reputation and improvement of corporate image is highly essential with respect to the quality of organizational services and products" (Toplu et al. 2014). However, there is little research that examines new technologies, such as social media, with respect to corporate reputation (Karjaluo et al. 2016).

The challenges of translating corporate identity into some form of corporate image or reputation, through an active communication strategy, are not new (Fombrun 2012; Gray and Balmer 1998). However, the advent of digital technologies that provide increased access to information about companies, while often simultaneously surrendering control of its management (i.e., what information is available to be seen and by whom) (Baka 2016), necessitates a contemporary examination of their role in this process. More than ever before, the future of competition for reputation and brand managers will include dynamics of both signal generating and signal managing technologies that support the control and appropriation of the greatest amount of *co-created* value possible. In

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this article, we introduce a typological model for corporate reputation management that both employs and expands upon *signaling theory* (Spence 1973) and responds to the need to examine the relationship of contemporary technologies—used for signal generating and signal managing capabilities—and corporate reputation (Boateng 2018; Karjaluoto et al. 2016).

Signaling theory (Spence 1973, 2002) is based on the notion that informational asymmetries may exist with respect to what two parties know about each other (e.g., job applicants and employers) and that each party may choose to engage in signaling activities that may bridge this gap. As this theory often embraces the cost of signaling as a key variable for determining the communication strategy, it is unsurprisingly been embraced in contemporary management research, particularly that involving reputation (Connelly et al. 2011). However, as the theory primarily focuses on reducing informational asymmetries, as opposed to enhancing, diminishing, or mitigating them (Courtney et al. 2017), and has not fully incorporated contemporary information technologies as part of the signal management process, there is an opportunity to gain both theoretical and practical insights. Identifying and broadening our understanding of modern information technologies, and how they may be used to create and manage the signals that lead to corporate reputation, is what we hope to address in this article.

We begin by building an awareness of the availability and utility of contemporary information technologies that affect a firm's *signal generation capabilities* and *signal management capabilities* (SGCs and SMCs). Through this knowledge of how various technologies are employed, and what capabilities they provide, we begin to see how information signals will be impacted. We then expound upon signaling theory, integrating the effect of such technologies on signal communication strategies that help determine corporate reputation, and drawing emphasis on the key concept of informational asymmetries. By evaluating the interaction between SGCs and SMCs, and building on the Kirmani and Rao (2000) typology, we introduce a behavioral classification typology that shows firms may *amplify*, *squander*, *mollify*, or *diminish* signals generated based upon their strategic signaling capabilities. Moreover, we link our proposed typology to reputational performance and discuss the indirect and contextualized effect of market and industry needs and costs. We end this study with a discussion of the theoretical and practical implications of our paper as well as some direction for future research—inspired by ethical considerations and this study's limitations.

New Technologies, Signaling Theory, and Corporate Reputation

New Technologies

New technologies such as Web 2.0 have allowed for interpersonal informational exchanges where consumer opinions, satisfaction, and ratings (of firms) may be freely generated and openly shared. Some firms have proactively invested in IT and adopted policies anticipating the need to generate and manage information signals that will affect their firm's reputation, both positively and negatively. Yet despite its obvious impact on business and society, prior results from investigations of benefits of IT investments on firm performance have been spurious, leading to what some call the productivity paradox (Brynjolfsson 1993; Brynjolfsson and Hitt 1996; Jones et al. 2012; Kraemer and Dedrick 2001). Firms continue to make investments in IT, not assured it will help their performance, or allow them to develop strong e-commerce capabilities for instance (Gregory et al. forthcoming), but hoping that there will be at least an indirect effect of some sort (Ravichandran et al. 2009). Many managers believe that such investments will perhaps create capabilities that will allow them to manage the diffusion of signals of high and low quality to the public (Kirmani and Rao 2000), where firm signals like *quality* are similar to reputation (Kreps and Wilson 1982).

A firm's ability to enhance reputational performance through investments in IT is contingent on the adoption and successful implementation of IT as an organization—this makes generating signals of quality possible. However, firms must also develop *signal managing capabilities* (SMCs) (Carmichael et al. 2011; Kirmani and Rao 2000) to ensure that any information about the firm and its offerings is seen by relevant stakeholders in such a way as to have a positive effect on its reputation. When new technologies emerge that allow customers and other stakeholders to interact and interpersonally exchange information regarding firm's products and services like never before, managers must decide how best to cope with the changes—and if it is worth the attempt at all.

Some IT investments such as ERP or Knowledge Management System, when implemented correctly, will create *signal generating capabilities* (SGCs) that increase the likelihood of producing positive signals about the firm related to productive or qualitative efficiencies. Some technologies, like the following, are more directly tied to firm operational efficiency and productivity, supporting signal generation of this nature. For example, *Business Intelligence 2.0* is a collection of tools that expand a firm's operational and other capabilities through internet

platforms (e.g., dynamic querying of corporate data by employees in remote locations) and provide dynamic, near real-time, access to corporate data (Mendoza 2010). *Enterprise Resource Planning* (ERP) systems help manage and integrate business processes across organizational functions and locations. ERP systems mainly integrate accounting, finance, human resources, and production processes (Soh et al. 2000). *Knowledge Management Systems* are information systems developed to support and enhance the organizational processes of knowledge creation, storage, retrieval, transfer, and application (Alavi and Leidner 2001). *Intranet It* is an internal (within the organization) computer network that helps to securely promote data sharing among users, fostering organizational communication and collaboration. *Automatic ID Systems* (e.g., magnetic cards, barcodes, RFIDs) are technologies used for identification and tracking and provide information about people, goods, and services in an automated manner, carrying information about the objects to which they are attached (Finkenzerler 2003). All such technologies help to improve efficiencies in operations that impact a firm's bottom line through enhancements in innovation, cost-cutting initiatives, responsiveness, and waste reduction among other things that may be signals later converted into corporate reputation.

Some technologies, like the Automatic ID Systems, may also or separately impact signals of qualitative efficiency, by indirectly improving the quality of the products or services and the user experiences. *Web-based CRM systems* help manage the firm's interactions with customers, clients, and relate to web technologies that help organize, automate, and synchronize processes related to sales activities, marketing, technical support, and customer service. *Web-based surveys* are tools for obtaining feedback from customers remotely through surveys that are delivered via the Internet with the responses stored in databases for further statistical analysis. Similarly, web-based consumer research uses customer information to identify marketing opportunities, evaluate marketing actions, and monitor marketing performance on a web environment. These technologies are unique in the sense that they are often user-generated signals where value in qualitative efficiency improvements, that are more subjective, is co-created through firm actions and customer feedback. In some cases, as with web-based consumer research, while using customer information to produce more targeted marketing campaigns, privacy issues associated with the sharing of customer information may also produce negative signals (e.g., Facebook or online platforms that house customer and information preferences).

A firm must also have sufficient managerial and organizational capabilities in order to fully capitalize on the investments (Carmichael et al. 2011) of such technologies though. Indeed, an organization must have both sufficient SGCs to

generate positive signals regarding performance, but also complementary *signal managing capabilities* (SMCs) (Carmichael et al. 2011) to maximize reputational performance by ensuring that positive signals generated are also received by appropriate stakeholders. Thus, investments in SMCs, that will complement SGC investments, are needed and will have a combined effect on a firm's reputational performance. Many of the technologies that produce signal of qualitative efficiency serve a dual-role, also supporting SMCs, as they are often the sources for disseminated information that is user-generated and co-created. Naturally, a firm's website is the main electronic portal which contains a set of related web pages with text, video, music, audio, and/or images content through which relevant stakeholders access information and can be easily managed by the firm. Web 2.0 platform technologies facilitate information sharing, interoperability, and collaboration that usurp some of this control from the firm. Web 2.0 applications deliver continually updated software, consume and mix data from multiple sources, and allow users to interact and collaborate. Examples include social network sites, blogs, wikis, and video sharing sites (O'Reilly 2007).

Indeed, customer ratings and review systems that enable customers to input and share their experiences with certain products and/or services from companies are much more difficult for firms to manage. So, while firms that produce positive signals because they are efficient, and provide good quality products and services, will want customers and other relevant stakeholders to know—thus reducing informational asymmetries that might exist—firms with less positive signals may not wish to know this information so readily. Having various technologies and understanding technological capabilities may yield more strategic options to firms (See Table 1 below for an overview of technologies). However, before we can explore such options and strategic positioning, understanding the relationship of signaling, and signaling theory, to corporate reputation is important.

Signaling Theory

Signaling theory has taken an increasingly important role in recent years, particularly in management research, as scholars and decision-makers have recognized the range of contexts and signal opportunities that exist (See Connelly et al. 2011 for a review). Managers and researchers, for instance, recognize that the information used by decision-makers in the public or between businesses is often incomplete, or asymmetric, meaning “different people know different things” (Stiglitz 2002: 469) and provides concerned stakeholders the opportunity to bridge this informational gap (Connelly et al. 2011). Signaling theory (Spence 1973, 2002) suggests that concerned stakeholders will attempt to reduce information asymmetries through the generation and

Table 1 Identification and classification of information technologies

Information technology	Description	Signal generation	Signal managing	Relationship to reputation	
				Productive efficiency	Qualitative efficiency
Business Intelligence 2.0	It is a collection of tools which help organizations expand their operations and capabilities through Internet platforms (e.g., dynamic querying of corporate data by employees in remote locations). These tools provide a dynamic, near real-time access to corporate data (Mendoza 2010)	X		X	
ERP system	It is a software package that manages and integrates business processes across organizational functions and locations. ERP systems mainly integrate accounting, finance, human resources, and production processes (Soh et al. 2000)	X		X	
Knowledge Management Systems	They refer to information systems for managing organizational knowledge. These systems are developed to support and enhance the organizational processes of knowledge creation, storage, retrieval, transfer, and application (Alavi and Leidner 2001)	X		X	
Intranet	It is an internal (within the organization) computer network which helps to securely share data among users. It constitutes an important component for internal organizational communication and collaboration. Generally, intranets access is restricted to employees of an organization	X		X	
Automatic ID Systems (e.g., magnetic cards, barcodes, RFIDs)	These systems provide information about people, goods, and services in an automated manner. These technologies are used for identification and tracking. They carry information about the object to which they are attached (Finkenzeller 2003)	X		X	X
Web 2.0	Web 2.0 uses the WWW as platform; it facilitates information sharing, interoperability, and collaboration. Web 2.0 applications deliver continually updated software, consume and mix data from multiple sources, and allow users to interact and collaborate. Some examples of Web 2.0 include social network sites, blogs, wikis, and video sharing sites (O'Reilly 2007)		X		X
Web-based CRM systems	They help managing the firm's interactions with customers, clients, and sales prospective. They are related to the usage of web technology to organize, automate, and synchronize processes related to sales activities, marketing, technical support, and customer service	X	X	X	X
Web-based surveys	These technologies are considered tools for obtaining feedback from customers remotely. Surveys are delivered via the Internet and the answers are stored in databases for further statistical analysis		X		X
Web-based consumer research	Consumer research is about using customer information to identify marketing opportunities, evaluate marketing actions, and monitor marketing performance on a web environment	X	X	X	X
Website	It is an electronic portal which contains a set of related web pages with text, video, music, audio, and/or images content. A website is hosted on a web server and can be accessed via Internet or a local area network	X		X	
Customer ratings and review systems	These systems enable customers to input and share their experiences with certain products and/or services from companies		X		X

dissemination of appropriate signals, which may at times be costly to produce. For instance, Spence (1973) used the pursuit of education in the labor market as a signaling proxy meant for potential employers to evaluate job candidates' quality. Other things being equal, job seekers hope to reduce information asymmetries by generating and providing more favorable signals about them, such as higher education, and previous related job experience which may lead potential employers to hire them instead of their counterparts. Thus, the process of signaling involves both the generation and dissemination or management of informational signals for interpretation and feedback from receivers (Connelly et al. 2011). Decision-makers must choose how and when to create or enhance signals and this process involves evaluating the cost-to-benefit analysis of whether to signal or not (Kirmani and Rao 2000).

Kirmani and Rao (2000) recognized that firms could be either high quality or low quality in nature and must decide whether to signal or not based upon the signaling cost in relation to other strategic alternatives. With respect to their notion of *adverse selection*, firms that cannot change the quality of their product will have the asymmetrical information void closed as soon as the product is consumed. This is similar to the notion of *experience-type goods* (Nelson 1970) wherein products must be 'experienced' by consumers for their value and quality to be properly assessed. Alternatively, there is the notion of *moral hazard* wherein a low quality firm might charge premium prices, altering the perception of quality, leaving the customer to discover the true quality after consumption (Rao and Monroe 1996). Of course, in both situations, the approach may be contingent on the prospect of repeat business and how likely this new knowledge discovered by one person's experience is likely to be shared publicly and believed by others. Naturally, firms that are high quality wish to have this information known but will only signal if the costs of signaling are cheaper and more effective than any other approach such as non-signaling (Kirmani and Rao 2000). Conversely, low-quality firms will prefer non-signaling so long as the benefits outweigh the costs of signaling (i.e., saying nothing versus trying to convey a different quality).

Managers must deal with this complex issue and attempt to provide the right values for their corporate brand experience in the internet setting (Hamzah et al. 2014), or at the very least the perception of these values. The prospect of repeat and first-time business relies heavily on this value perceived, and co-determined, by the consumer groups offering their experiences online and shaping the perception of the company. Naturally, providing a quality experience will encourage repeat buying behavior (Alwi and Ismail 2013; Hamzah et al. 2014) and shaping perceptions of quality is likely to encourage first-time business by allowing satisfied customers to share experiences that signal the firm is

reputable. For instance, service firms rely more heavily on qualitative performance signals, such as increases of quality or customer service experiences (Wang et al. 2003). Unlike industries in which products may be examined and compared prior to consumption (e.g., retail clothing, electronics, automobiles), services frequently do not allow sampling prior to consumption and more similar to experience-type products. Potential consumers of services must therefore seek out alternative sources of information available to them which serve as sampling proxies in their evaluative process.

Such qualities in the consumption of services are not dissimilar to co-creation of value found online in digital communities using Web 2.0 (Toplu et al. 2014) technologies. In other words, like the consumer playing in active role in determining the value of services as they are being consumed, the general public found in online communities is now playing a more active role in signal generation through consumer rating and other platforms for user-generated content (Baka 2016). This means that firms must regard signaling decisions as rather important, particularly in an age where social media and other information sharing platforms exist and where experiences may be shared. Social media and such information sharing platforms afforded by Web 2.0 technologies seem to add another layer of complexity with which managers must contend. While signaling theory mainly explores the reduction of informational asymmetries from a cost-based perspective, there is a need to examine how signals from multiple sources, that may not all be entirely under the control of the firm, can interact to increase or reduce informational asymmetries. From this perspective, the costs of trying to produce and manage different signals may lead to various strategies for firms dependent on their capabilities and the importance of corporate reputation to them or their industry.

Corporate Reputation

Corporate reputation is variously defined, but it may be thought of as the "overall knowledge and esteem of the corporation held by the general public" (Fombrun 1996) and as a socially constructed concept (Rindova et al. 2006). As information sharing is a key aspect to what knowledge is available, and social media platforms play such a vital role in where the public gets its information, exploring the role of social media in corporate reputation management is of great strategic importance. For example, according to a recent Pew Research Center survey, "two-thirds (67%) of Americans report that they get at least some of their news on social media" (Shearer and Gottfried 2017). Without their own previous experience to inform judgements, information-seeking parties, such as potential consumer groups among the general public, will look for signals about the experiences and opinions of others to fill this informational void. These

signals will complement any others provided by the firm itself. The fact that roughly only one quarter of Americans get their news from more than one social media platform (Grieco 2017) may both help and hurt those attempting to manage reputation with respect to what signals are seen and by whom.

Reputation is as an integral component of competitive strategy building (Hall 1993; Raithel and Schwaiger 2015; Roberts and Dowling 2002; Weigelt and Camerer 1988) as consumers seek out information related to firm products and services prior to purchase. As a social construction, reputation is based on constituents' individually derived expectations (Philippe and Durand 2011; Rao 1994; Rindova and Martins 2012) in relation to information available to them often times stemming from the society and its expectations of behavior. Corporations seeking to generate positive reputation will promote the diffusion of positive signals to the public such as solid accounting-based performance indicators, signals of conformity to institutional or social norms, and strategic posturing (Fombrun and Shanley 1990; Philippe and Durand 2011; Rao 1994, Stevens and Makarius 2015). These signals are what the public perceives and interprets as reputation (Basdeo et al. 2006; Su et al. 2016) which is valuable to firms seeking a sustained competitive advantage because it is non-substitutable, non-transferable, and very difficult to duplicate (Barney 1991; Hall 1993).

Reputation is a form of collateral used in lieu of other transaction costs, or premiums, and is established by initial expenditures and the forfeiture of short-run gains (Klein et al. 1978). As with signaling theory, where firms may attempt to ascribe costs to bridging informational asymmetries, building corporate reputation may be expensive and managers should seek to generate and manage it as efficiently as possible. While some IT investments improve the productivity and performance of service firms by generating enhanced signals of quality (information) that may be similar to reputation signals (Kreps and Wilson 1982), other technologies are crucial to the management of this information both inside of the firm and in the market (Carmichael et al. 2011; Carr 2003). As part of the strategic management process, understanding that firms operating in the digital age must simultaneously assess costs of signaling and level of control they have over signaling is important to finding the correct position along the efficiency frontier vis-à-vis investment in signal generation and management technologies.

Reputation is an intangible asset that can generate future rents (Weigelt and Camerer 1988) as it helps attract higher quality workers (Highhouse et al. 2003), better investors (Milgrom and Roberts 1986), brand strength and loyalty (Huang et al. 2014; Strandvik and Heinonen 2013), and of course more consumers (Park and Lessig 1981). Organizations must attend to multiple audiences, or stakeholders, that evaluate their productive efficiency, their compliance with societal norms

(DiMaggio and Powell 1983), and the quality and value of their services in comparison to their competitors (Fombrun 1996; Fombrun and Shanley 1990). These audiences we call the public, use the information signals the firm generates as the basis for decisions regarding the best places for them to work, the most well-run companies to invest in, or the firms from which they will likely obtain the highest-quality services in the market. While not all signals received by the public are under a firm's control, a firm can actively manage the type of signals it sends out to various constituents, hoping to promote the positive signals and suppress the negative ones (Kirmani and Rao 2000). Naturally, a firm's communication strategy in relation to managing signals that lead to reputation may be viewed as cost-based investment analysis, allowing the firm to select the best outcome, its current situation, and cost to signal.

As consumers increasingly lack the ability to search out products and services and evaluate them prior to purchase, a result of advancements in internet technology and the proliferation of online shopping through platforms such as Amazon.com, the ambiguity and informational asymmetry that exists between service providers and the public increases the likelihood that the latter will search for information elsewhere (Fombrun and Shanley 1990; Shrum and Wuthnow 1988). "Publics construct reputations from available information about firms' activities originating from the firms themselves, from the media, or from other monitors (Fombrun and Shanley 1990: 234)." Fombrun and Shanley (1990) argue that even with informational asymmetries between managers and constituents, without the heterogeneity presented by multiple stakeholders, reputation would be irrelevant. Reputation is not only a reflection of a firm's ability to meet or exceed the expectations of different stakeholder groups (Freeman 1984), it also informs the public, through performance signals, about its ability to meet current and future expectations (Fombrun and Shanley 1990; Wilson 1985). Consequently, prior firm activities ($t-1$), such as investments in IT, create informational signals that various stakeholders evaluate in the present (t), and also affect decision making, which creates additional signals used for evaluation in the future ($t+1$) (Connelly et al. 2011; Fombrun and Shanley 1990; Wilson 1985). Firms that rely heavily on reputation must attempt to provide as many positive signals they can to relevant constituents, and suppress as many negative ones they can, if they hope for stakeholder support in the future.

Theory Development

SGCs, SMCs, and Reputation

The sudden and rapid increase of investments in IT during the latter half of the 1990s led some to classify its

prominent role as the “new economy” (Beyers 2003). Yet, despite the perceived commitment to invest in IT in order to remain competitive in the new economy, many researchers were unconvinced that such investments actually led to increases in firm performance (Brynjolfsson and Hitt 1996; Carr 2003; Thatcher and Oliver 2001). Ensuing research argued that simply investigating the relationship between IT investments and performance was insufficient as a great deal of the related outcomes were based on the internal capabilities of the firm (i.e., managerial skills, adaptation, absorptive capacity) required to effectively manage and implement these systems (Boynton et al. 1994; Carmichael et al. 2011). Indeed, the resource-based perspective (RBV) (Barney 1991) recognizes that firms are dependent on specific resources that create value for the firm, the extent to which it is contingent on their rarity, non-substitutability, and inimitability. Yet, RBV also recognizes that the value of such resources as IT is truly contingent on the organizations ability to exploit them better than another firm. This creates a distinction for some between resources, which might be purchased in the strategic factor market by any bidding firms (Barney 1986), and capabilities, which require complex coordination of multiple sets of resources and are more difficult to duplicate (Amit and Schoemaker 1993).

Consequently, researchers have come to understand that creating a competitive edge in the new economy is not simply about investing more in IT than rival firms. In order to take full advantage of those investments, companies should hire managers and employees capable of adopting and effectively implementing new complementary technologies. While most firms now seek to create IT capabilities in order to enhance their performance, new technologies such as Web 2.0 that help manage the information created by classic IT have highlighted the necessity for information signal management capabilities (Carmichael et al. 2011). Prahalad and Ramaswamy (2004) argue that the future of competition involves recognizing and managing the co-creation of value, new technologies make this process increasingly complex. The requirement for SMCs is even more apparent for firms competing against one another on the basis of secondary sources of information that help determine a firm's reputation. Expanding on the relationship between IT investments and firm performance requires recognition of the mediating effect of corporate reputation, which is formed on the basis of information signals generated and managed by firms. Moreover, distinguishing between classic IT investments, which are responsible for generating the information (productive and qualitative efficiency signals) received by the relevant stakeholders, and new technology investments, which help manage that information, is also critical.

Corporate reputation is enhanced among relevant stakeholders due to SGC IT investments by generating positive information signals; increasing its qualitative and productive

efficiencies. *Qualitative efficiency* relates to qualitative measures, such as quality enhancements, variety, or customer service, which signal how a firm performs in terms of creating differentiated value in the eyes of stakeholders (i.e., consumers, employees, investors). *Productive efficiency* refers to statistical productivity measures, such as labor productivity or technical efficiency, which signal how a firm performs in terms of minimizing costs and maximizing revenues. Productive efficiency signals affect corporate reputation by demonstrating to such constituents as investors or employees that the company is a favorable place to invest in or work for, respectively.

Perhaps more important to service firms, qualitative efficiency sends signals to consumers, as well as other stakeholders, that the firm's service offerings are of higher value or quality as compared to other firms within their industry. Providing a higher quality experience online will influence online buyer behavior (Alwi and Ismail 2013; Hamzah et al. 2014) indirectly enhancing performance through corporate reputation. Thus, not only is the generation of measurable signals of efficiency important, it is also clear that managing signals that constituents use to create reputation is an important moderating consideration. Moreover, understanding and efficiently utilizing technologies that help manage information stakeholders use to evaluate firms, such as a firm's website, Web 2.0, Web-based CRM systems, and Customer Rating and Review Websites, among others, will likely improve a firm's reputational performance (Carmichael et al. 2011). Accordingly, we consider the important construct of SMCs as a complementary moderator to the relationship between productive and qualitative efficiency signals and corporate reputation. See Fig. 1 for a pictorial representation of the conceptual model.

In services where customers rely heavily on information signals to comparatively evaluate companies, investments in such technologies as Business Intelligence 2.0, ERP systems, and Knowledge Management systems, all increase the likelihood of generating positive signals and experiences that may be shared among external constituents. Business Intelligence 2.0 is a collection of tools which allow

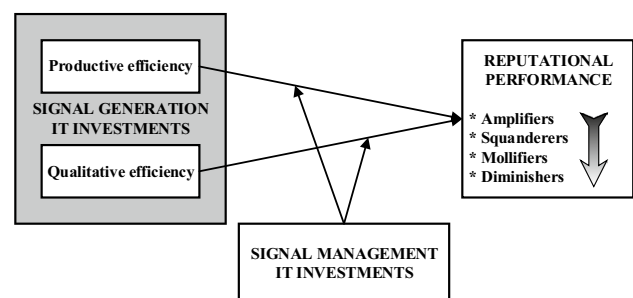


Fig. 1 Conceptual model

organizations to expand their capabilities through Internet platforms (e.g., dynamic querying of corporate data by employees in remote locations) and provide dynamic, near real-time access to corporate data (Mendoza 2010). Provided that organizational capabilities are in place to leverage such technologies, these investments would likely enhance productive efficiency measures such as labor productivity and technical efficiency, and are also likely to increase qualitative efficiency by facilitating employees' ability to serve consumers in remote locations, thus increasing a firm's differentiated value. Knowledge Management Systems expedite the organizational processes of knowledge creation, storage, retrieval, transfer, and application (Alavi and Leidner 2001) while ERP systems help facilitate the coordinated use of such information throughout accounting, finance, human resources, and production processes (Soh et al. 2000). Such technologies not only enable organizations to increase the speed and accuracy of their operations by saving time, money, and improving customer service quality (all potential signals of a well-run company desirable to investors) but may also increase the work-life quality for employees, signaling to potential employees that it is a great place to work.

While IT investments coupled with IT management capabilities increase the likelihood of generating positive signals through enhancing productive and qualitative efficiency measures, much of the long-term value of such information may be squandered if not managed properly. Indeed, new technologies such as Web 2.0, online customer ratings and review systems, and web-based surveys allow for unprecedented access to information sharing not only between the organizations and their stakeholders, but also between former and prospective clients. For example, Web 2.0 applications deliver continually updated software, consuming and mixing data from multiple sources, and allowing users to interact and seamlessly share information between one another. Examples of Web 2.0 systems include social network sites, blogs, wikis, and video sharing sites (O'Reilly 2007). Similarly, customer rating and review systems enable consumers to input and share their experiences with certain products and/or services from companies; lately, many companies are relying on voice-to-technology (V2T) to interact with customers (Ellway 2014). Firms that have both the technological capabilities to produce positive signals, and to manage them such that the greatest amount are shared with relevant constituents, have the best shot at maximizing their corporate reputation.

Firm Behavioral Classification and Typology

Ultimately, firms with the best reputation should also see the best sustained financial performance in industries where reputation matters the most. In order to develop the best reputation possible firms must possess a complement of superior

IT capabilities in both generation and management of signals ensuring that any positive information about qualitative and productive efficiency is seen and shared by the appropriate stakeholders in the general public and online communities. Such firms we refer to as *signal amplifiers*. However, not all firms have or want to have such complementary capabilities. Firms that produce more positive signals have high levels of signal generation capabilities, whereas those that produce more negative signals (perhaps just few positive signals) have low signal generation capabilities. In some cases, firms may produce many positive signals, but fail to ensure relevant stakeholders see them. These firms have low signal management capabilities and we refer to as *signal squanderers*. Alternatively, firms may produce negative signals but attempt, ethically or not, to ensure relevant stakeholders do not see them and the information void persists or is too costly for consumers to close. These firms have high signal management capabilities and we refer to as *signal mollifiers*. Obviously, these capabilities may complement or offset one another in some cases dependent on the managerial decisions and strategy. As with all strategic initiatives involving reputation, the choice of which capabilities to develop may be based on the resources available to invest and whether reputation matters in the firm's industry and market. This of course influences the choice firm may make in relation to positions in the cost-based efficiency frontier for online signaling and management. In monopolistic or oligopolistic industries or markets, for instance, a firm's reputation may not matter as much because stakeholders have fewer choices for where to allocate their resources. Consequently, in such industries and markets, some firms do not need to produce positive signals and do not need to actively manage them for any relevant stakeholders. These firms may have both low signal generation and low signal management capabilities and we refer to as *signal diminishers* (Table 2).

Table 2 Firm behavior classification towards reputation by the interaction of SGCs and SMCs

Signal generation capabilities IT investments	High	Squanderers (e.g. Healthcare companies, financial and banking firms, insurance firms)	Amplifiers (e.g. Hospitality firms, airline companies, travel agencies)
	Low	Diminishers (e.g. Utility firms, government agencies, educational institutions)	Mollifiers (e.g. Law firms, restaurants, consulting firms)
		Low	High
Signal management capabilities IT investments			

Darker cell shading represents higher reputational performance

Signal Amplifiers

Signal amplifying firms are most likely found in highly competitive markets where reputation matters a great deal as a strategic asset. In these markets, there are likely high levels of sophistication and use of Web 2.0 technologies and other forms of interactive interpersonal information sharing applications. As a result, these firms typically possess high signal generation capabilities SGCs from investments in IT and supporting organizational design that enhance qualitative and productive efficiency. In addition, these firms usually possess high SMCs from similar investments in IT and organizational design. Firms that operate in this strategic position realize that the benefits of investing in technologies that enhance their positive signals and manage them favorably in the online communities outweigh the costs of such investments. These firms frequently engage with third-party sites and typically promote the co-creation of value through user-generated content, effectively reducing informational asymmetries, especially when it is to their benefit.

Airline companies are part of a very competitive industry with many options in alternative close airports, carriers, and pricing. Nevertheless, a common requirement is an utmost customer service to passengers, which is directly related to the firm reputation. In an attempt to provide a better, accurate, and timely customer service in relationship to their flight reservation, data handling, pricing, flight information, and communication with other reservation systems such as hotels and rental cars, the majority of airlines companies implemented computer reservation systems (e.g., Sabre, Amadeus, Navitaire) that use IATA (International Air Transport Association) standard coding and requirements. In the context of our study, all these firms invested in signal generation systems that increased productive and qualitative efficiencies.

Many more airline companies went above and beyond by implementing signal management systems in an attempt to provide an even better service to their customers. Those firms rely on firm apps, which can be installed on smartphones and provide real-time flight information about delays, cancelations, schedule changes, bag carousel information, gate changes, departure reminders, and so on. Information provided to customers on a timely manner is critical in this industry, and companies doing so enhance their reputational performance. The result is an *amplification* of the positive signals seen by relevant stakeholders.

Proposition 1 *Firms that have both high SGCs and high SMCs, signal amplifiers, are likely to have the most favorable reputations.*

Signal Squanderers

Signal squandering firms may be found in less competitive markets, where reputation does not matter as much as a strategic asset, or in markets with less sophisticated use of interpersonal information sharing applications, if they have managed to survive. Such industries may have high levels of productive efficiency, but as they do not rely heavily on such metrics to be converted into reputation, the cost of investing in SMCs is too high given the returns in generating value through corporate reputation. On the other hand, there are perhaps some firms that either do not possess the resources to invest in SMCs, even though they would like to and should, or cannot as effectively implement them as competitors. Such firms may not survive long as they typically possess high levels of SGCs but fail to ensure that positive signals regarding productive and qualitative efficiency are seen by relevant stakeholders as effectively as they should. In this case, squanderers actually create the worst kind of informational asymmetry for businesses, lots of positive information signals that cost money to create, but that the relevant stakeholders do not see as they should. Signaling theory would suggest that managers take a hard look at the cost to increase their SMCs in such cases and examine the cost-to-benefit ratio especially if so many positive signals may be converted into a favorable reputation.

Healthcare industry-related companies such as hospitals might be good examples for squanderers. These firms have important investments in signal generation technologies that increase their productive and qualitative efficiencies as they have to accurately manage patients' personal information and medical treatments. The healthcare industry is highly regulated and includes standard procedures that are closely monitored due to their effects on customers' well-being. There is a plethora of inpatient electronic health record systems that are currently utilized by hospitals in the U.S., some of them are Meditech, SigmaCare, MedConnect, among others. Nevertheless, most of the hospitals do not invest in signal management systems as they should be doing, indeed, a truly lost opportunity to reap more reputational benefits attained from their SGC IT investments. Few of them invest in SMC systems, but they limit to basic information sharing with patients (e.g., appointment reminders, cancelations, and similar) since providing an inaccurate information would have more detrimental consequences than providing limited information. As a result, their reputational performance will typically be lower than amplifiers, but higher than mollifiers. These firms have low SMCs that result in a *squandering* of the positive signals generated.

Proposition 2 *Firms that have high SGCs but low SMCs, signal squanderers, are likely to have moderately favorable reputations.*

Signal Mollifiers

Signal mollifying firms are likely found in more competitive markets, where reputation does matter to the firms, and in markets where there are more sophisticated information sharing applications in use by relevant stakeholders. These firms are either incapable of investing in appropriate IT that can lead to positive signal generation or possibly have been unable to develop sufficient organizational capabilities to support and benefit from the investments. The latter partially explains the productivity paradox but also indicates a firm's inability to fully capitalize on its investment. These firms typically have low SGCs and will not survive unless the negative signals regarding productive and qualitative efficiency are hidden from the relevant stakeholders. As a stop-gap solution, firms may use high SMCs in an effort to temporarily obfuscate negative information resulting in signal *mollification*. Such firms recognize that either the costs of managing to mollify the negative information through investments in SMCs is much lower than the costs to invest in SGCs that can produce positive information signals long-term, or that investments in SMCs can be a valuable short-term solution, or stop-gap measure, until SGCs start producing positive signals. In this case, mollifiers actually create a better, albeit less ethical, kind of informational asymmetry for businesses, negative information signals that the relevant stakeholders should see but do not. Signaling theory would suggest that managers take a hard look at the costs to increase their SGCs in such cases and examine the cost-to-benefit ratio and risk analysis surrounding suppressing or mollifying bad signals, as this is likely to only be a temporary solution in the digital world.

Restaurants are some of the hardest businesses to manage successfully when so much of the success is contingent on reputation. The slightest of bad experiences, even when rare, can be very damaging if shared by consumers. They can also be good examples for mollifiers. These firms typically need to make just enough SGC IT investments to reach parity with the industry standards. They have to invest in IT systems for order accuracy (e.g., customers want the food they ordered), protect customers' payment information, inventory management for perishable goods, and personnel scheduling, among the most relevant. Thus, SGC IT investments are low for restaurants. Since the success of a restaurant depends also on the word-of-mouth and recommendations, SMCs investments are critical for companies in the food industry; they have to manage signals about their organizations properly, especially the negative ones. RestoConnection, an online magazine for restaurant managers, is an important source for tips and hints on how to manage restaurants. For example, one article published in December 2017 is titled "Restaurant Reputation Management: How to Handle Bad Buzz." It provides

recommendations to managers to respond quickly to customers' questions and reviews, to remove bad reviews and comments when appropriate, to apologize wherever is necessary, and to respond to false comments and mistakes. Hence, restaurants need strong SMCs to get reputational gains. Mollifiers' reputational performance will be lower than squanderers, but higher than diminishers.

Proposition 3 *Firms that have low SGCs but high SMCs, signal mollifiers, are likely to have moderately unfavorable reputations.*

Signal Diminishers

Signal diminishing firms, which are able to survive, are likely found in less competitive markets where reputation does not matter much or perhaps the ability of stakeholders to freely acquire and exchange relevant information is unsophisticated or impeded. If these markets do value reputation and the interpersonal information exchange is highly developed and unencumbered, the firms will not likely be able to sustain this position long. These firms are unwilling or unable to invest in either SGCs or SMCs resulting in positive signal *diminishment*. Firms that operate in this strategic position either are state or government sponsored or possess significant monopolistic advantages rendering the need to promote quality or manage signal quality an unnecessary cost. Such firms may also operate in commodity products driven by price and productive efficiencies such that reputation only matters when prices are the same, those firms with larger scale economies are likely to be signal diminishers as well. In this case, diminishers actually do not create or reduce informational asymmetry for businesses, lot of negative signals may be created but they do not really try to hide it. Signaling theory would suggest that managers be careful in those industries that might suddenly become more competitive through deregulation or other market forces.

For example, Department of Motor Vehicles' (DMV) offices might be considered as diminishers of reputational signals. The majority of DMV's customers rank it lower in the reputation spectrum due to its outdated technology, limited supporting technologies such as toll-free numbers or internet-based procedures in some locations, bureaucracy, long waiting times, and pre-disposition of customers against DMV's experience, among others. However, civil documentation requires DMV customers to visit their offices sporadically and their only real incentive to invest in technologies is to reduce costs for the government. Clearly, low investments in SGC and SMC systems would have a detrimental effect on reputational performance; as a result, diminishers possess the lowest.

Proposition 4 *Firms that have low SGCs and low SMCs, signal diminishers, are likely to have highly unfavorable reputations.*

Discussion

Implications for Theory and Practice

Theoretical Implications

Building upon signaling theory (Spence 1973, 2002), we continue to embrace its utility for use in management research (Connelly et al. 2011). We respond to the need to examine the relationship of contemporary technologies, used for signal generating and signal managing capabilities, and corporate reputation (Boateng 2018; Karjaluoto et al. 2016). In particular, we focus on how such technologies further complicate the decisions to signal involving informational asymmetries. Courtney et al. (2017) recognize that signals coming from various source may enhance or diminish one another and we build on this notion in the context of a digital world. We examine the role SGCs and SMCs play in reducing and in some cases creating informational asymmetries both purposefully and by accident. It is only logical that in a world dominated by information technologies creating an abundance of information, not all information generated will be seen and managed properly. We further emphasize how this affects the cost-based approach to signaling theory and add new dimensions to the approach. In so doing, we update the relationship model surrounding communication strategies for converting corporate identity into reputation (Gray and Balmer 1998) to include contemporary technologies.

Practical Implications

Managers must take note of how new technologies may be used to manage reputation in relation to their needs and the costs of investments. Companies wishing to compete effectively in a world dominated by the creation and use of information must establish internal capabilities that complement investments in IT and maximize reputational performance for the lowest cost possible. New technologies have emerged such as Web 2.0 and customer review and rating websites facilitating an open exchange of information never before seen in commercial activities and making the development of signal generation and management capabilities important determinants of reputational performance. These technologies make the processing of controlling information much more challenging for managers and much costlier. As with any strategic decisions, there are often trade-offs and compromises that must be made with respect to how best to allocate limited resources, such as human and financial capital,

that could build signaling and managing capabilities. In our typology, managers should recognize their situation or position and decide the right approach to creating and managing contemporary technologies that may be complementary or in some cases substitute for one another.

Key Lessons

Complementarity and Substitutability

While developing IT capabilities to increase a firm's efficiency in both SGCs and SMCs that help to create and control the dissemination of information about the firm will presumably both increase a firm's reputational performance by complementing one another, they may also be substitutes. If a firm makes a considerable investment in IT and has sufficient organizational capabilities to significantly increase its productive and qualitative efficiency, it will generate a host of positive information that may be exploited, albeit less efficiently, without strong SMCs. Unfortunately, if the company lacks sufficient SMCs it may not effectively transfer this information to relevant stakeholders who may reward the firm with higher esteem or reputation, squandering some of its potential return on investment. Conversely, if a firm's IT capabilities create inefficiencies and in turn negative information signals regarding the organization, having high SMCs that control the diffusion of such information to relevant stakeholders. This may prevent further long-term damage and effectively serve as a substitute for productive and qualitative inefficiencies of insufficient or poor IT investments, effectively mollifying negative information that is relevant to stakeholders. Thus, understanding the exact relationship between IT that contributes to different capabilities may inform the decisions of executives limited in their ability to make investments in both types of IT.

Exploring strategic options by cost and value. Understanding the exact relationship of such capabilities to generate and manage information in a digital world requires a more fine-grained methodological approach in consideration of the applicable value derived from producing and disseminating information to stakeholders. Further examination may expose the exact relationship between traditional IT capabilities, which produce information (signals) about a firm's productive and qualitative efficiencies, and new technologies (SMCs), which manage the information about a firm available in the public forum, online or elsewhere. In addition to the benefits of high SMCs, ethical considerations must be considered with respect to what information a company chooses to disseminate and what information it attempts to suppress (Kirmani and Rao 2000). While suppressing inaccurate negative information and promoting accurate positive information may be ethical, promoting inaccurate positive information and suppressing accurate negative information

is not. Of course, as the value of a company's products or services is increasingly co-determined by online evaluators, there should also be increasing attention on the ethical responsibilities of the public in online communities. A poor experience, or less than satisfactory outcome in consuming a product or service, may lead to exaggerated promotion of negative information by a consumer. In relief of contemporary debates on 'fake news' permeating social media platforms such as Facebook, the ethics and regulation of information and disinformation may become a battleground for consumers and companies alike.

Limitations and Directions for Future Research

This research has several limitations and we mention a few as possible directions for future research. As a conceptual paper, there are obvious limitations toward proving our arguments that examples and anecdotal evidence may not sufficiently address. An empirical analysis of some of the relationships we discuss could provide unique insights toward the lesser known connection between social media type technologies and corporate reputation (Karjaluoto et al. 2016).

Methodological Considerations

Attempting to directly measure the impact of IT investments on reputational performance is a tenuous and complicated process as there is a list of additional moderating and mediating relationships which should be considered. First, research must take into account the proper measurement of inputs and outputs in light of the technologies implemented. While certain technologies (e.g., ERP, Business Intelligence 2.0) are likely to directly enhance long-term performance by creating productive efficiencies, they may also produce qualitative efficiencies (e.g., service quality improvements, better working conditions) which will indirectly benefit the firm in the long-term. Second, IT characteristics should be distinguished when exploring the effect of investments as some technologies help produce information about the company, such as changes in efficiency, while others help manage the dissemination of information into the public. Third, organizational capabilities moderate the outcome of IT investment of both types, signal generation and signal management, the co-specialization of which create capabilities (Carmichael et al. 2011). Fourth, information itself cannot directly benefit the firm. It must be leveraged into a more convertible resource such as corporate reputation, which takes a long time to develop and is of particular importance in service industries. Fifth, corporate reputation is an intangible asset that can generate future rents (Weigelt and Camerer 1988), but it remains a multidimensional construct derived mainly from information relevant to multiple stakeholder groups. Thus, exploring its impact on long-term performance may

benefit from measuring more tangible consequences such as attraction of higher quality job seekers (Highhouse et al. 2003) and investors (Milgrom and Roberts 1986), increases in consumption (Park and Lessig 1981), or higher prices for services (Klein and Leffler 1981). Sixth, reputation indicators are fairly widespread; however, how they are derived may affect the results. For example, the Fortune.com list of the World's Most Admired Companies is frequently employed; however, this ranking is largely representative of the opinions of businessmen and other executives likely to favor information signals about accounting efficiency or other productive efficiency measures. The Reputation Institute™ provides alternative measures more comprehensively including the opinions of consumers or in many cases the general public who may be aware of a company and yet have never experienced its products or services. These opinions are often based upon those signals important to the evaluating constituents, and therefore considerable care must be placed on which signals they react to that are generated and managed by IT.

Ethical Concerns

Our paper also does not fully address the many ethical concerns surrounding the use of information technologies. The increased ability to control and not control the information that flows from the firm into the public carries with it a considerable amount of ethical ambiguity. For instance, executives at Enron had sufficient control over the organizational inefficiencies in order to extract rent from their company shares prior to its collapse, leaving many employees and other investors in financial distress. Had an organization such as Enron survived, such types of information asymmetries established from the suppression of information would have considerable negative repercussions on its reputation (Kim and Choi 2003). On the other hand, suppressing information about minor inefficiencies or infractions may save a company a great deal of unnecessary problems, which are often compounded by full disclosure.

Alternatively, consumers who share information on ratings and review sites have a considerable effect on a firm's reputation, both individually and collectively, leaving some question as to the ethical obligation of a firm's stakeholder, such as this, to be accurate in the information he or she shares. Indeed, new service providers such as Reputation.com seek to help small businesses manage the information available about them on the internet, by increasing the availability of positive information while attempting to suppress the negative. As a result of the advent of such information management technologies, a considerable burden is placed on both organizations and stakeholders, to determine what type of information is made available for exchange and

where to draw the line in provision of an ethical amount of disclosure.

There are also issues associated with the creation of data and privacy laws, such as with social media giants such as Facebook. In these cases, how information technologies are used to gather data and generate signals becomes a large concern worth examining, as does the role of government and the creation and dissemination of information. In this case, government regulations may play a prominent role in how managers elect to build their signaling capabilities and what options they have.

Conclusion

In this article, we examine the new technologies that play a role in generating and managing signals that may be converted into corporate reputation. We respond to the need for an increased examination of the outcomes of new technologies on corporate reputation and further signaling theory by examining the effects of such technology on informational asymmetries. By incorporating contemporary technologies into the relationship between a firm's signaling or communication strategy and corporate reputation, recognizing the interplay of SGCs and SMCs, we introduce a new behavioral classification typology for firms' strategic management. This typology of signal management strategy includes signal amplification, squandering, mollification, and diminishment positions and is contingent on the importance of reputation to firms and tactical approaches from a position and cost-based perspective. We discuss the theoretical and practical contributions, highlighting some key lessons on the complementarity and substitutability of certain IT capabilities and ethical considerations for practitioners and researchers, as well as limitations and directions for future research.

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