IT-enabled Knowledge Ambidexterity and Innovation Performance: The Role of Social Media Capability

Completed Research Paper

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Abstract

This study examines the impact of information technology (IT) infrastructure on knowledge ambidexterity and innovation performance, and the potential amplifier role of social media capability on this equation. The proposed theory is tested using the structural equation modeling technique and the partial least squares method of estimation employing a secondary dataset on a sample composed of the 100 small U.S. firms included in the 2013 Forbes America’s Best Small Companies ranking. The empirical analysis suggests that IT infrastructure enables the firm to explore new knowledge and exploit existing/new knowledge to innovate more and better. We also find that social media capability has an amplifier role on this equation as follows: (1) IT infrastructure and social media capabilities dance together to enable knowledge ambidexterity, and (2) knowledge ambidexterity and social media capabilities also dance together to pursue innovation-based competitiveness.

Keywords

IT infrastructure, knowledge exploration and exploitation, social media capability, innovation performance.

Introduction

In the contemporary environment, intangible resources difficult to imitate such as knowledge management have the potential for explaining a significant portion of firm performance variation (Alavi & Leidner 2001; Sher & Lee 2004). The use of information technology (IT) enables the social interaction among organizational members to share insights and clarify viewpoints, which is needed for an effective management/application of knowledge (Mueller et al. 2011; Ramesh & Tiwana 1999). In this sense, IT support is a key ingredient to facilitate a firm’s knowledge management.

Prior Information Systems (IS) research has mainly focused on studying the relationship between IT and innovation activities and performance (e.g., Agerfalk et al. 2009; Chen et al. 2015; Kim et al. 2011; Kleis et al. 2012; Srivastava & Shainesh 2015), and examining the IT effects on knowledge management processes and performance (Choi et al. 2010; Tamriderdi 2005). On a different way, we focus on knowledge ambidexterity (a specific knowledge management capability). However, with a few exceptions (e.g., Eservel 2014; Joshi et al. 2010), research on the impact of IT on knowledge management and innovation activities is very limited. For example, Joshi et al. (2010) find that IT applications enable to absorb knowledge to increase innovation outputs. Eservel’s (2014) case study illustrate that IT supports processes of the firm’s knowledge creation (i.e., socialization, externalization, combination, and internalization) for open innovation activities.
The firm’s usage of social media for business activities (beyond marketing) is a new corporate phenomenon, and our understanding is in its initial stages (Braojos et al. 2015a; Kane et al. 2014). Social media may provide additional customer and industry data to digitally convert information in knowledge to innovate. A counter-argument could be that firm’s employees may spend unproductive time on social media that could otherwise have been used for knowledge exploitation and innovation. Based on the first argument, we theorize that IT infrastructure enables the development of knowledge ambidexterity (i.e., firm’s ability to simultaneously explore and exploit knowledge for operational purposes) to increase innovation performance, and that social media capability (i.e., the firm’s ability to leverage social media to execute business activities) may perform an amplifier role in this equation. We test our theory using the structural equation modeling (SEM) technique and the partial least squares (PLS) method of estimation with a secondary dataset on a sample of 100 small U.S. firms.

The empirical analysis supports our theory. This study contributes to the IS research on social media for business activities by developing the concept of social media capability and theorizing how this capability amplifies the relationships between IT infrastructure, knowledge ambidexterity, and innovation performance.

**Theory and Hypotheses**

**IT Infrastructure and Knowledge Ambidexterity**

IT infrastructure capability is the firm’s ability in leveraging its technical and human IT resource infrastructure (Weill et al. 2002) to acquire/provide accurate and timely information from/to key organizational members (Bharadwaj 2000; Mithas et al. 2011; Pavlou & El Sawy 2006). Technical IT resources include servers, computers, laptops, operating systems, software, electronic communication networks (email, Intranet, Extranet, wireless devices), and shared customer databases (Aral & Weill 2007; Benitez & Ray 2012). Human IT resources refer to the IT and business skills of IT managers and employees (Byrd & Turner 2001; Chen et al. forthcoming; Wang et al. 2015).

Knowledge management is the continuous process of creation, acquisition, storage, sharing (Mueller et al. 2011), and usage of knowledge at firm level (Choi et al. 2010; Lee 2001). The process starts with obtaining new knowledge. Codification of knowledge is needed in order to easily transfer and retain it into the firm. The process continues with transferring and sharing the knowledge among the organizational members. And finally, it ends up with knowledge application which enables organizational members to propose solutions based on that knowledge to solve operational problems (Sabherwal & Sabherwal 2005), and to increase competitiveness (Alavi & Leidner 2001).

Two critical concepts/phenomena can be highlighted from knowledge management: exploration and exploitation of knowledge. Knowledge exploration refers to the processes that help the firm to acquire/create, assimilate, and store new knowledge (Joshi et al. 2010). Knowledge exploitation indicates the transformation, application, and leveraging of existing/new knowledge into the firm (Joshi et al. 2010). On a different way of prior IS research on IT and innovation activities, this study focuses on knowledge ambidexterity capability that refers to the firm’s ability to simultaneously explore and exploit knowledge for operational purposes (Levinthal & Ahuja 1993; Tushman & O’Reilly 1996).

IT infrastructure can enable the firm to pursue knowledge ambidexterity. First, the ability to get/share information from/to the market enabled by IT infrastructure can facilitate the acquisition/creation of new organizational knowledge. IT technical and human resource infrastructure supports the firm to better manage information and facilitates the conversion of information into useful new knowledge (Shih et al. 2012), thus enabling the exploration of knowledge. For example, Google continuously collects a huge amount of market/trading data (i.e., knowledge) from Internet to be analyzed. Based on this new knowledge Google is able to make accurate prediction about different issues in the market (Coles et al. 2007). Another example on how IT infrastructure enables the firm to explore and exploit useful new knowledge is the firm Wyndham International, who goes online to extract and transfer all the consumption data to an IT application called ByRequest, which facilitates the data analysis to be converted into practical knowledge (Piccoli & Applegate 2003). Second, IT infrastructure provides the firm IT tools to better connect with upstream suppliers and downstream customers (Kim et al. 2011), and becoming more flexible to rapidly assimilate, apply and leverage new/existing knowledge among the organizational members (Benitez & Ray 2012; Chen et al. forthcoming; Mehta et al. 2014), thus enabling knowledge
exploitation. Hence, we hypothesize that:

Hypothesis 1 (H1): There is a positive relationship between IT infrastructure and knowledge ambidexterity.

**Knowledge Ambidexterity and Innovation Performance**

Innovation performance refers to the outcomes of the process of making changes on existing products/processes and/or the development of new products/processes arising from internal and external knowledge (Joshi et al. 2010; Kleis et al. 2012).

Knowledge ambidexterity can facilitate innovation performance. Overall, knowledge capabilities help the firm in understanding complex technical knowledge, hence contributing to the creation of new innovations (Joshi et al. 2010). Indeed, the ability to innovate may be considered as one of the critical contributions of knowledge management (e.g., Gold et al. 2001), which may be extended to knowledge ambidexterity. Ambidextrous firms are able to continuously improve current processes and obtain novel alternatives (Patel et al. 2012; Raisch & Birkinshaw 2008), because ambidextrous new product teams are more efficient and faster to understand the market, enhancing the effectiveness of new product development task (Lubatkin et al. 2006). Thus, firms that use “learning-by-experimentation” (exploration) and “localized learning” (exploitation) may maximize innovation.

Specifically, knowledge exploration can improve innovation performance. The acquisition/creation and sharing of new knowledge within/beyond the firm's boundaries brings more new knowledge elements into the firm, increasing the potential number of innovations (Henderson & Clark 1990). For example, the different backgrounds and expertise interacting and collaborating among supply chain partners enable the firm to acquire new knowledge to develop new products. This capability can propel creative thinking and the sharing of ideas into the firm, thus improving innovation performance (Lubatkin et al. 2006). Moreover, exploration enables access to different technological areas, adding diversity and heterogeneity that help in new knowledge creation. With this new knowledge, more impactful innovations may be created (Rosenkopf & Nerkar 2001).

On other hand, firms that better apply and leverage existing/new knowledge (knowledge exploitation) can outperform competitors in terms of more effective changes on existing products/processes, thus improving the firm’s innovation performance. Using the same knowledge repeatedly increases the level of experience and the understanding about the product’s requirements. This enables that the product development task can be easily addressed (Eisenhardt & Tabrizi 1995). Also, repeated usage of knowledge elements allows understanding better the firm’s knowledge and strengthens the ability to identify the valuable knowledge, to connect and to mix different elements in novel and significant ways (e.g., Katila & Ahuja 2002). Finally, prior empirical research has found that firm’s exploration and exploitation capabilities have a positive impact on the development of new products (Gupta et al. 2006; Newell 2015).

Therefore, we hypothesize the following relationship:

Hypothesis 2 (H2): There is a positive relationship between knowledge ambidexterity and innovation performance.

**The Amplifier Role of Social Media Capability in the Relationship between IT Infrastructure and Knowledge Ambidexterity**

Social media capability refers to the firm’s ability in leveraging the social media platforms of Facebook, Twitter, and blogs to execute business activities (Braojos et al. 2015a). We argue that in presence of social media capability, the relationship between IT infrastructure and knowledge ambidexterity can be stronger, that is, social media capability can perform an amplifier role in this relationship.

Social media capability provides a vast amount of data on the market (customers and competitors) which may be used to digitally explore and exploit knowledge. Social media also facilitate superior and faster information flows within the firm, and for the course of interaction with suppliers and customers/the market (Sultan 2013). Certainly, these data and superior information flows enabled by social media may increase the opportunities to leverage IT resources to explore and exploit new/existing knowledge. Indeed, social media enable a richer range of social connection that IT can support, and may facilitate the movement of information (Kane et al. 2014). For example, organizational members can acquire customer
insights/feedback (i.e., new knowledge) from the firm’s Facebook and Twitter site and better assimilate this new knowledge through the databases and the enterprise resource planning system of the firm, thus enabling knowledge exploration.

Similarly, multiple types of information technologies can be needed for an effective leveraging of knowledge (Sultan 2013). These information technologies can be macro-IT capabilities as IT infrastructure or micro-IT capabilities such as e-business technology, social media, or cloud computing (Braojos et al. 2015b; Mueller et al. 2011), which also suggests that the impact of IT infrastructure on knowledge exploitation can be stronger when the firm has also proficiency in leveraging social media. Then, it is rational to expect that IT infrastructure and social media capability can dance together to explore and exploit knowledge:

Hypothesis 3 (H3): Social media capability positively amplifies the relationship between IT infrastructure and knowledge ambidexterity.

The Amplifier Role of Social Media Capability in the Relationship between Knowledge Ambidexterity and Innovation Performance

We argue that the relationship between knowledge ambidexterity and innovation performance can be also amplified by social media capability. First, social media are valuable tools to effectively manage knowledge within firms (Sultan 2013) as they facilitate relationships and strategic networking (Kane et al. 2014), and the exchange of ideas enhancing innovativeness (Kim et al. 2011; Ramesh & Tiwana 1999). For example, Danone has implemented some IT-based knowledge management programs as Who’s Who or Dan 2.0 where employees can interact for job tasks. Dan 2.0 is an internal social media platform that helps Danone to convert organizational knowledge in innovative solutions to problems. In the Danone launch of biscuits in Finland, where people do not eat them for breakfast (i.e., something that Danone's marketing managers did not know initially), Danone was able to reposition the marketing campaign into a biscuit for little hungers in the mid-morning. This was possible thanks to the knowledge sharing from LU France to LU Norway employees that allowed Danone to maximize its marketing campaign (Beyersdorfer et al. 2011; Edmondson et al. 2008). Second, social media empower organizational members and end-users to engage in the firm’s innovation activities, thus enabling open innovation (Joshi et al. 2010). It is probable that ambidextrous firms in knowledge can transform more easily new/existing knowledge in new products/processes if they have also proficiency in social media. We therefore hypothesize the following:

Hypothesis 4 (H4): Social media capability positively amplifies the relationship between knowledge ambidexterity and innovation performance.

Research Methodology

Sample

We empirically test the proposed model with a sample of the 100 small firms included in the 2013 Forbes America’s Best Small Companies ranking (in short, the Forbes database), which includes the best 100 U.S. publicly small firms with sales under one billion dollars (Braojos et al. 2015a). The firms included in the sample came from 30 industries: consulting (18 firms), IT (16), food manufacturing (seven), semiconductor manufacturing (six), healthcare (five), chemical (five), and other industries (43).

Data and Measures

To measure the constructs included in the proposed model we collected and used a secondary dataset that comes from eight different databases. We started collecting the data from the 2013 Forbes database and using the name of each firm, we gathered the information from the other databases.

We performed a structured content analysis of the 2013 and 2014 firm’s annual reports collected from the U.S. Securities and Exchange Commission Filing database, and measure IT infrastructure as the accumulated total number of firm’s initiatives/mentions on technical and human IT resource infrastructure in 2013 and 2014 (Joshi et al. 2010; Luo et al. 2012). Drawn from Braojos et al. (2015a, 2015b) we used a list with 35 keywords on technical and human IT resources, and carefully read the resultant paragraph in the firm’s annual report computing each keyword one per paragraph where appears
to calculate the accumulated total number of firm’s initiatives on IT resource infrastructure.

We conducted a structured content analysis to measure knowledge ambidexterity construct. We adopt the same measure scheme as Joshi et al. (2010), who measured knowledge management capability as the accumulated total number of firm’s IT applications that enable knowledge management activities with information from LexisNexis and Knowledge Management World databases. Knowledge Management World is a business magazine covering news on how IT is used to develop business knowledge activities/capabilities. The process of coding consists in carefully reading the news on 21 keywords published in 2013 and 2014, and deciding whether the firm uses/applies the specific IT application or not, distinguishing between the IT applications that help the firm to acquire, assimilate, and store knowledge (knowledge exploration), and those the IT applications that help the firm to apply and use organizational knowledge (knowledge exploitation) (Joshi et al. 2010).

We measure social media capability as a second-order construct determined by Facebook capability, Twitter capability, and blog capability (Braojos et al. 2015a, 2015b) with data collected in June 2014. We evaluate Facebook capability through the number of past or future events, experience and updates with data collected from the Facebook site of the firm. Following Braojos et al. (2015a), we measure the firm experience on Facebook as the average number of months that the firm operated on Facebook, and the update by scoring with 1/2/3/4/5 when the firm had made a comment on Facebook more than one month ago/two weeks ago/in the last week/in the last two days respectively. Twitter capability is measured in terms of spent time writing tweets, experience, and updates with data collected from the firm’s Twitter site and Twopcharts database (http://twopcharts.com/). The spent time writing tweets is measured as the average hours that firm has spent writing tweets, and the experience and update are measured on a similar way that for Facebook. Blog capability is measured through experience and updates of the firm on blogs with data collected from the firm’s blog site.

Innovation performance is the key endogenous variable of this study. We measure this variable with information collected from the U.S. Patent and Trademark Office database in the period 2007-2014, as follows: firstly, we estimate a patent quality weighting ratio (PQWR) by dividing the number of citations received by the firm’s patents of a year from subsequent patents within a three year window among the number of published patents in a particular year (Kleis et al. 2012). We use the three year window to avoid vintage effects of older patents (Kleis et al. 2012). In this way, the number of patents in a particular year is weighted by the number of citations that these patents have received in the following three years. This is a patent measure that focuses on quality of the patent instead of only on the number of patents. We estimate a PQWR for 2007-2010, 2008-2011, 2009-2012, 2010-2013, and 2011-2014. Secondly, based on these PQWR values, we build a ranking by industry where the firms have a better position as greater the PQWR is. After that, we calculate the rate of sectoral excellence (RSE) in innovation based on this firm’s ranking position in its industry (Benitez & Walczuch 2012; Benitez & Ray 2012). RSE is estimated as follows RSE = 1 - (Firm’s position in its industry in our PQWR ranking / Total number of firms in each industry in our PQWR ranking). This generates five indicators on RSEs in innovation for 2007-2010, 2008-2011, 2009-2012, 2010-2013, and 2011-2014 for each firm included in the sample.

We control for firm size, industry, and firm age on innovation performance with information collected from the 2013 and 2014 Forbes database. We measure firm size as the natural logarithm of the average number of employees in 2013 and 2014 (Benitez & Walczuch 2012). We measure industry as a dummy variable (0: Manufacturing firm, and 1: Service firm). Firm age is measured as the natural logarithm of the number of years operating in its industry in 2014 (Chen et al. 2015).

Empirical Analysis and Results

Method of Estimation, Measurement Model Evaluation and Test of Hypotheses

We empirically test the proposed model by using the SEM technique and the PLS method of estimation employing SmartPLS 3.2.3 Professional software package (http://www.smartpls.com) (Benitez et al. 2013; Chin 2010). It is rational to use PLS in this research because two of our constructs (i.e., knowledge ambidexterity at first-order level and social media capability at second-order level) are specified as formative, and PLS is particularly appropriate for estimating this type of models (e.g., Chin 1998). Also, the use of PLS is particularly advisable to estimate models that employ secondary data, like our model.
Prior to data collection, we verified the validity of our measures with two executives. For reflective first-order constructs, we evaluate reliability, convergent, and discriminant validity. To assess reliability, we calculate its composite reliability and its indicator loadings being above the suggested threshold of 0.707 (Chin 2010). The average variance extracted (AVE) of the construct were evaluated to see whether AVE values reach the suggested value of 0.500. Discriminant validity is ensured since the square root of the construct AVE is higher than the horizontal and vertical correlation among constructs (Braojos et al. 2015b; Chin 2010). Formative constructs at first- and second-order level should be evaluated differently through the assessment of multi-collinearity, weights, and loadings and their level of significance (Petter et al. 2007). To ensure that multicollinearity is not a problem in our data, we evaluate the variance inflation factors (VIF) for formative indicators/dimensions which are between 1.387 and 1.412, so they meet the suggested threshold of 10 (Petter et al. 2007). After running a bootstrap analysis with 5000 subsamples, we observe that the dimension weights and loadings are significant for knowledge exploration, knowledge exploitation, and Facebook capability so these indicators and dimension can be retained (Benitez & Ray 2012; Braojos et al. 2015b; Cenfetelli & Basellier 2009). The dimensions weights for Twitter capability and Blog capability are not significant, but their dimensions loadings are, so these dimensions can be also retained to preserve content validity (Cenfetelli & Basellier 2009). Overall, the proposed model presents good measurement properties (Table 1).

To test the hypothesized relationships, we evaluate the beta coefficients and its significance, the effect size, and R² values of the proposed relationships. Figure 1 presents the results of the test of hypotheses. H1 and H3 are supported at 0.001 level, so IT infrastructure enables knowledge ambidexterity and this relationship is particularly amplified when firm has the ability to leverage social media for operational purposes. H2 and H4 are supported at 0.05 level, so knowledge ambidexterity and innovation performance is found to be positively associated, and this relationship is stronger in the presence of firm’s social media capability. The beta coefficients of hypothesized relationships range from 0.328*** to 0.456** and the R² values for these relationships are 0.337 and 0.418. The effect size (f²) values of the key relationships of the proposed model range from 0.104 to 0.272. Overall, the proposed model shows good structural model evaluation results. The empirical analysis thus supports our theory.

**Test of Robustness**

We check for the robustness of the proposed model by estimating two alternative models. In the first alternative model, we assume that knowledge ambidexterity affects the development of an IT infrastructure capability, which in turn affects to innovation performance, keeping the moderating role of social media capability. This alternative model presents lower beta coefficients than our proposed model ranging from -0.238† to 0.365***. In the second alternative model, we consider that innovation
performance affects knowledge ambidexterity through IT infrastructure, keeping the moderating role of social media capability. In this model, most of the beta coefficients are also lower than in our proposed model, ranging from 0.124† to 0.448**. To compare these alternative models with our proposed model we additionally use SRMR, a goodness of structural model fit measure in a PLS estimation. These two alternative models have greater SRMR values, which it suggests the proposed model is the best and more rational explanation of the data (Henseler et al. 2014).

<table>
<thead>
<tr>
<th>Construct/indicator</th>
<th>Composite reliability</th>
<th>Loading</th>
<th>AVE</th>
<th>VIF</th>
<th>Weight</th>
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<tbody>
<tr>
<td>IT infrastructure</td>
<td>0.992</td>
<td></td>
<td>0.984</td>
<td></td>
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<tr>
<td>IT infrastructure 2013</td>
<td>0.992***</td>
<td></td>
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<tr>
<td>IT infrastructure 2014</td>
<td>0.993***</td>
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<tr>
<td>Knowledge ambidexterity</td>
<td>0.978***</td>
<td>0.705***</td>
<td>1.412</td>
<td>0.583</td>
<td>1.683</td>
</tr>
<tr>
<td>Social media capability</td>
<td>0.807</td>
<td>0.643***</td>
<td></td>
<td>0.685</td>
<td>1.387</td>
</tr>
<tr>
<td>Facebook capability: Facebook activity of the firm in terms of:</td>
<td>0.811</td>
<td>0.643***</td>
<td></td>
<td>0.721***</td>
<td>0.922***</td>
</tr>
<tr>
<td>Twitter capability: Twitter activity of the firm in terms of:</td>
<td>0.848</td>
<td>0.723***</td>
<td>0.628***</td>
<td>0.685</td>
<td>1.387</td>
</tr>
<tr>
<td>Blog capability: Blog activity of the firm in terms of:</td>
<td>0.811</td>
<td>0.643***</td>
<td></td>
<td>0.721***</td>
<td>0.922***</td>
</tr>
<tr>
<td>Innovation performance</td>
<td>0.948</td>
<td></td>
<td>0.865***</td>
<td></td>
<td></td>
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<tr>
<td>RSE 2007-2010</td>
<td>0.865***</td>
<td></td>
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<tr>
<td>RSE 2008-2011</td>
<td>0.888***</td>
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<td>RSE 2009-2012</td>
<td>0.851***</td>
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<tr>
<td>RSE 2010-2013</td>
<td>0.905***</td>
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<tr>
<td>RSE 2011-2014</td>
<td>0.914***</td>
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</table>

Table 1. Measurement Model Evaluation at First- and Second-order Level

Mediation Analysis

We perform a mediation analysis in two ways: (1) We add the direct effect between IT infrastructure and innovation performance, which is not significant (-0.033); and (2) estimating and analyzing the indirect effect involved in the proposed model (0.176*) (Zhao et al. 2010). The indirect effect is significant. This
analysis reinforces the results obtained in the test of hypotheses and indicates that IT infrastructure influences innovation performance through knowledge ambidexterity, which is amplified when the firm has also the ability to leverage social media for business activities.

**Discussion and Conclusions**

This research makes two contributions to the field of IS. First, with a few exceptions (Eservel 2014; Joshi et al. 2010), research on the impact of IT on knowledge management and innovation activities is very limited. Our paper provides new evidence on how IT infrastructure enables the exploration and exploitation of organizational knowledge to increase innovation performance. On a different way of prior IS research, we focus on knowledge ambidexterity (an idiosyncratic knowledge management capability) in small firms. Second, this study develops the concept of social media capability and theorizes how this capability amplifies the relationships between IT infrastructure, knowledge ambidexterity, and innovation performance, which it is critical to better understand the role of social media for business activities.

This research has also limitations. First, our findings can only generalized to small firms in the U.S. market. What is lacking is to explore whether the proposed theoretical model is also supported on samples of small firms of other different markets (e.g., European Union, Latin America, Asia). Second, we focus on a sample composed of firms that come from 30 industries.

The findings of this research provide two critical lessons for IT managers. First, leveraging IT technical and human resource infrastructure provides the foundation to explore and exploit new ideas to finally change/develop better products/processes. Second, the prior lesson can be amplified if their firm indeed invest and leverage Facebook, Twitter, and blogs. These lessons can help IT managers to create business value from their IT/social media investment decisions.

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