Does Business Intelligence Leverage Dynamic and Operational Capabilities? Impacts on Marketing Processes in Telecom Companies

Completed Research

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Abstract

Despite growing investments in Business Intelligence and Analytics, the business value generation process associated with the adoption of these technologies is still unclear. Consequently, managers face difficulties in justifying such initiatives and subsequently evaluating their results. In this study, we propose and statistically evaluate a causal model that connects the availability of BI&A resources and capabilities in a company to its operational marketing capabilities. Marketing processes are critical for the generation of innovations in products and services and operational revenues, and thus for a firm's performance and competitiveness. In order to assess our model, we applied structural equation modeling techniques to data collected in a large Brazilian Telecommunications company. Our results suggest that the positive effect of BI&A resources and capabilities on a company's marketing capabilities is fully mediated by its dynamic capabilities. The practical and theoretical implications of our findings are discussed.

Keywords

Business Intelligence and Analytics (BI&A), Dynamic Capabilities, Resource-Based View (RBV), Marketing Capabilities.

Introduction

Interest in Business Intelligence and Analytics (BI&A) has grown over the last years, despite the challenges to assess its capacity to generate business value. BI&A can be understood as a set of tools, technologies, applications, and processes for gathering, storing, accessing, and analyzing data to generate useful business information and help users make better decisions (Namvar, Cybulski, & Perera 2016; Wixom, B. & Watson 2010). Investments in BI&A is a top priority in organizations worldwide (Gartner, 2016). Its global market is expected to reach $20.8 billion in 2018, and US$22.8 billion by 2020 (Ghosh 2018), despite the skepticism of managers and researchers regarding the actual return generated by BI&A systems (Fink, Yogev & Even, 2017; Trieu, 2017).

In this study, we attempt to shed light on this issue by proposing and assessing a causal model that connects BI&A resources and capabilities to a company’s operational marketing capabilities. Furthermore, we argue that the positive impact of BI&A occurs insofar as it leverages dynamic capabilities that are essential to innovation in products and services promotion and commercialization (Easterby-Smith, Lyles and Peteraf, 2009; Teece, 2014). According to the Dynamic Capability Theory (Helfat et al., 2007; Teece, 2007), dynamic capabilities are essential to the development and renewal of an organization’s internal and external resources and assets, reconfiguring them as needed to innovate and respond to market and business environment changes (Teece, 2014).
We test our model with data collected in a large Brazilian telecommunication company. The company provides voice and data services on fixed or mobile platforms, as well as additional value-added services, such as media and storage solutions for home consumers and businesses. Given that the Telecom market is characterized by intense turbulence, strong competition, and constant product and marketing innovation, a company’s dynamic capabilities and operational marketing capabilities should be critical to its performance and competitiveness (Cavusgil, Seggie & Talay 2007; Teece, 2014).

**Conceptual Model and Hypotheses**

Since the publication of Teece, Pisano and Shuen’s (1997) seminal work, several authors have been developing conceptual and empirical studies based on Dynamic Capability Theory (Wilden, Devinney and Dowling, 2016). In particular, Pavlou and Sawy (2011) proposed and evaluated a model that identifies, conceptualizes, and measures the processes related to the operationalization of dynamic capabilities in companies, namely: (1) environmental monitoring, i.e. the ability to perceive, interpret, and capture opportunities and threats in the environment; (2) learning, which is the ability to create new knowledge through the use of both pre-existing and new knowledge; (3) integration, i.e. the ability to integrate individual knowledge into collective shared knowledge; and (4) coordination, which is the ability to utilize the resources and capabilities obtained and integrated to effectively achieve new organizational capabilities. According to the same authors, to examine the effects of dynamic capabilities on organizational performance in turbulent environments, it is necessary to understand their links to operational capabilities and how these are reflected in the company’s business processes. Thus, the effect of dynamic capabilities on a company’s performance is considered to be mediated by their operational capabilities. Similarly, several researchers suggest that improvements in organizational performance and the attainment of competitive advantage do not derive directly from a company’s dynamic capabilities; rather, they are a result of the configuration and effective reconfiguration of their operational capabilities and resulting resources (Eisenhardt and Martin, 2000, Helfat et al., 2007, Helfat and Peteraf, 2003, Pavlou and El Sawy, 2011, Teece, 2007).

Processes related to understanding and meeting customer needs, typically associated with an organization’s marketing and sales activities, are especially dependent on the availability of information on the external environment and are particularly affected by changes in the external context (Cavusgil, Seggie and Talay, 2007, Easterby-Smith, Lyles and Peteraf, 2009, Morgan, Vorhies and Mason, 2009, Song et al., 2005). Therefore, and considering the importance of marketing processes for generating innovations in products and services and operational revenues, the relationship between such processes and the dynamic capabilities of a company becomes critical to its performance and competitiveness, especially in turbulent environments (Teece, 2014). Thus, we propose the following hypothesis:

**H1:** The dynamic capabilities of an organization have a direct and positive effect on its operational marketing capabilities.

The Dynamic Capability Theory suggests that the positive effects of these capabilities are more intense in turbulent environments, which are those characterized by changes that affect how companies compete and respond to the needs of their customers (Helfat et al., 2007; Teece, 2007; Teece, Pisano and Shuen, 1997). In such contexts, if there is no renewal of existing operational capabilities, the competitive advantages eventually achieved by a firm may be lost (Protogerou, Caloghirou and Lioukas, 2012). On the other hand, turbulent environments can also generate new opportunities, which often require the reconfiguration of resources and capabilities existing in a company for it to capitalize upon those opportunities (Van den Bosch, Volberda and De Boer, 1999).

Pavlou and Sawy (2011) relate an environment’s turbulence to the frequency and volume of changes, and to the level of uncertainty present in its market. Two factors are important to define the level of dynamism of the business environment: (1) market turmoil, associated with uncertainties regarding customer demands and competitors’ strategies; and (2) technological turbulence, related to the frequency of technological advances relevant to the firm’s operation. The empirical results obtained by Pavlou and Sawy (2011) suggest that the greater the degree of turbulence in a company environment, the more positive are the effects of its dynamic capabilities on the performance of new product development processes. Likewise, a dynamic environment requires an organization to employ its monitoring, learning, integration, and coordination capabilities to develop, customize, offer, and monetize the promotion and commercialization of its products.
and services in a fast and aligned way to the needs of Customers and their positioning, while also considering the strategies adopted by competitors. Thus, the following hypothesis we define the following hypothesis:

**H2:** The positive effect of dynamic capabilities on an organization’s operational marketing capabilities is moderated by the level of turbulence in the company’s environment: the higher the level of turbulence, the more intense the effect.

BI&A systems and related technology’s characteristics, critical success factors, impacts, and evolution are the subject of several studies developed in the last decades (Fink, Yogev and Even, 2017; Gandomi and Haider, 2015; Gomes et al., 2011 Wixom, Watson and Werner, 2011, Wixom, Yen and Relich, 2013). Chen, Chiang and Storey (2012), for example, through a broad literature review, have identified the main technological characteristics and capabilities related to three stages of BI&A evolution, proposing research topics and guidelines for educational programs in Business Intelligence and Analytics.

In a more recent literature review, Trieu (2017) analyzed the process by which BI&A systems generate value for the organizations that adopt them, highlighting aspects that need to be investigated more thoroughly, such as the connections between investments, BI&A assets (or capabilities), organizational impacts, and value generated. Fink, Yogev and Even (2017) went further, proposing and evaluating a model for value generation through investments in Business Intelligence. Their results suggest that investments in BI&A infrastructure generate value for the organization as they enable the development of Business Intelligence capabilities. Yeoh, Richards, and Wang (2013) detail the process of developing these capabilities, suggesting that the effective application of BI&A artifacts and knowledge, in the business context, depends on the organization’s ability to absorb, integrate and exploit new knowledge, ie, its absorptive capacity (Lane, Koka and Pathak, 2006; Roberts et al., 2012). Yeoh et al. (2013) argue that the company’s BI&A assimilation generates positive impacts on several business processes (e.g., customer relationships, marketing and sales, operations), since it provides better inputs for decision making and the development of new products and services.

The effective use of BI&A systems would enable companies to obtain, consolidate, and analyze external and internal data to improve decision making, create and customize products, services and solutions, develop more effective marketing campaigns, and so on (Chen, Chiang and Storey, 2012, Fink, Yogev and Even, 2017, Trieu, 2017). BI&A systems can thus help an organization better understand its internal and external organizational environment, by contributing to the development of new knowledge from merging and sharing prior knowledge with insights gained from static and predictive model analyses (Chen, Chiang and Storey, 2012; Yeoh, Richards and Wang, 2013).

According to Pavlou and El Sawy (2011), the main components or dimensions of dynamic capacities (i.e., understanding the external environment, learning, integrating resources, and coordination) depend on the availability and sharing of information and knowledge about the environment in which a firm operates and its own internal processes (Pavlou and El Sawy, 2011; Teece, 2007). Thus, we believe that Business Intelligence resources and capabilities can generate value for an organization insofar as they help it to develop its dynamic capabilities, which, in turn, allow operational resources and capabilities to be obtained and aligned with the needs of the business. Therefore, we propose:

**H3:** The company’s dynamic capabilities completely mediate the effects of the availability of BI&A resources and capabilities on the company’s operational marketing capabilities.

**Research Method**

We conducted a quantitative cross-sectional study (survey), measuring the constructs of interest through the available scales in the literature. All scales used were Likert type, with five levels (1 = strongly disagree, 5 = strongly agree).

We measured the *availability of BI&A resources and capabilities* using the BI&A competence scale proposed by Yeoh et al. (2013). It includes items to evaluate the main construct’s dimensions, namely: BI&A structure, BI&A operation and BI&A team.

We measured *dynamic capabilities*, *environmental turbulence*, and *operational marketing capabilities* using the scales developed by Pavlou and El Sawy (2011). In the authors’ work, they defined these constructs...
as being multidimensional. The dynamic capabilities construct consists of four dimensions: environment understanding, learning ability, integration ability, and coordination ability. The dynamic environment construct entails the market turbulence and technological turbulence dimensions. The operational marketing capability construct entails the technical capability, costumer understanding capability, and managing capability dimensions.

Following the original definitions (Pavlou and El Sawy, 2011; Yeoh, Richards and Wang, 2013) and recommendations made in the literature (Mackenzie, Podsakoff and Podsakoff, 2011), we adopted reflexive measurement models for the constructs availability of BIA resources and capabilities, dynamic capabilities, and operational marketing capabilities. For the environmental turbulence construct, we used the measurement training model (Diamantopoulos and Siguaw, 2006).

Since the constructs involved in the study hypotheses are defined either at the group, business unit, or organization level, scores obtained at the individual level had to be grouped by their arithmetic mean. For this, we calculated the agreement scores between the respondents in the same group, using the $R_{WG}$ index (LeBreton and Senter, 2007).

As control variables, we used average work group tenure, group size, and percentage of male group members as indicators of diversity.

The data analyzed in the study was collected from a large multinational Telecom company in the Brazilian market, which, at the time, had a gross monthly revenue of over R$ 2.0 billion, specifically from the organization’s Retail Department (B2C), which was responsible for all assignments related to the commercial process, including segmentation, definition of sales channels, creation of new products and offers, pricing, direct and indirect marketing, monetization, retention, and sales. The Department is divided into 388 management offices, distributed throughout the nation, and employed 3,578 employees. Since 2014, this Department has been the focus of a BIA corporate structuring project. The purpose of the project was to integrate the Board’s key information into a single platform that was easy to access and use, and that enabled visual exploration of business data. However, the system had not yet been fully adopted by the entire Retail Directorate administration, with substantial differences in intensity and manner of use between the offices. In addition, the Department’s geographical distribution exposed its offices to reasonably distinct business environments, due to the differences between the regional markets in which they operated. Thus, although the areas operated according to the same policies, structures, and internal systems, they were probably subject to different levels of turbulence in the external environment. This allowed internal factors of influence on organizational performance to be controlled, while ensuring variations in the constructs of interest.

During the data collection, we did not include employees who worked in stores, because they did not have direct contact with the internal processes of the company. As a result, the research universe was limited to 187 offices and 1,224 employees, who enacted the entire cycle of retail activities.

The data was collected through an electronic questionnaire, made available to potential participants. In addition to the above scales, the survey also included questions to obtain the demographic data from participants (gender, age, tenure, educational level).

After obtaining authorization from the company’s HR to conduct the research, an invitation to participate in the study was sent to potential participants by e-mail. The invitation contained an explanation of the survey’s purpose, the link to the electronic questionnaire, warranting that their answers would be anonymous and that the data would be assessed only by the researchers.

From the 1,224 employees invited, 202 answered the electronic questionnaire. Of these, only 131 answered the survey completely. The distance of Mahalanobis (Riani, Atkinson and Cerioli, 2009) was used to identify outliers, with a level of significance ($\alpha$) of 0.001. After the elimination of the identified observations, the final sample consisted of 116 individuals, distributed in 42 work groups. The calculated $R_{WG}$ indices were close to or greater than 0.70, which is the value traditionally recommended in the literature (LeBreton and Senter, 2007). In this way, the individual scores for the constructs of interest could be aggregated to the group level.

Approximately 53% of the final sample was of male employees, and 47% of female employees. Almost all respondents (99%) had either graduate or postgraduate educational level. Their average company tenure
was 6.66 years, with a standard deviation of 6.19. The average group size in the sample was of 12.19 employees, with a standard deviation of 7.96.

The study hypotheses were statistically evaluated through Partial Least Squares (PLS) structural equations, using the SmartPLS 2.0 M3 software. PLS has shown to be robust to violations of multivariate normality, in addition to being able model formative and reflexive constructs, and also to be capable to run smaller samples, which is not the case in covariance-based structural equations modelling (Chin, 2010; Hair et al., 2017). In order to calculate significance effects, we used the bootstrapping technique with 1,000 samples of 42 cases each.

**Results**

Due to the small sample size, decreasing the number of parameters estimated in the PLS analysis was necessary. For this reason, the construct dimensions were used as indicators of the respective latent variables. The scores in each dimension were calculated as the arithmetic average of their indicators’ values. Figure 1 shows the model evaluated in the study.

![Figure 1: Theoretical Model](image)

A confirmatory factorial analysis (CFA) was conducted to evaluate the quality of the study measurement model. All indicators presented statistically significant loads ($\alpha = 0.01$) and above 0.70, while also not being substantially associated with any latent variables other than those corresponding to their respective constructs.

Table 1 summarizes the overall results for the measurement model. The values of Average Extracted Variance (AVE), Compound Reliability (CR), and Cronbach’s alpha ($\alpha_c$), and the fact that the square root value of AVE for each variable was higher than the correlations of the respective latent variable with the others prove the convergent and discriminant validity of the variables measured (Chin, 2010; Hair, Ringle and Sarstedt, 2013). It is worth noting that although Cronbach’s alpha for operational marketing capabilities is below 0.70, AVE and CR – a value which is better for indicating scale reliability – are above those recommended in the literature (Chin, 2010).
Figure 2 shows the results obtained for the structural model. The variance proportion of the constructs of interest explained by the model were substantial ($R^2 = 0.39$ and $0.50$, respectively, for dynamic capacities and marketing operational capacities). These results indicate that the proposed model is able to explain the variables of interest.

As predicted in H1, the dynamic capabilities variable had a positive and statistically significant impact ($\beta = 0.51$, $p < 0.05$) on the operational marketing capabilities variable. This result suggests that organizations with solid dynamic capabilities tend to also have more technically-developed marketing processes, managements, and understanding of the behavior and needs of their customers.

<table>
<thead>
<tr>
<th>Latent variables</th>
<th>Ind.</th>
<th>Average</th>
<th>Std. Dev.</th>
<th>AVE</th>
<th>CR</th>
<th>$\alpha_C$</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. BI&amp;A resources and capabilities</td>
<td>3.00</td>
<td>2.07</td>
<td>0.42</td>
<td>0.66</td>
<td>0.85</td>
<td>0.81$^b$</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2. Dynamic capabilities</td>
<td>4.00</td>
<td>2.05</td>
<td>0.55</td>
<td>0.77</td>
<td>0.93</td>
<td>0.62$^c$</td>
<td>0.88</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3. Op. marketing capabilities</td>
<td>3.00</td>
<td>1.99</td>
<td>0.38</td>
<td>0.53</td>
<td>0.77</td>
<td>0.42</td>
<td>0.61</td>
<td>0.73</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Reflexive constructs measuring model results

On the other hand, no empirical support was obtained for H2, since the effect associated with the interaction between the variables dynamic capacities and environmental turbulence was not statistically significant ($\beta = -0.18$, $p = 0.28$). It is worth noting that the estimated effect of the market turbulence dimension on the latent variable environmental turbulence was not statistically significant either ($\beta = 0.39$, $p = 0.18$). This indicates that, in the estimated model, this variable seems to be more strongly associated with the respondents' perceptions regarding the intensity of technological changes in the Telecom environment, than with changes in the behavior of customers and in the set of products and services offered by competitors. Although the development and offer of technological alternatives are important to the telecommunications industry, the measurement form chosen for the environmental turbulence construct could not adequately capture the full scope of its domain. It is possible that, at least partly, the rejection of H2 was due to this. Another possible explanation is a likely decrease in the power of statistical tests caused by the small number of observations in our sample.

Finally, we verified that the BI&A resources and capabilities variable had a significant positive effect on dynamic capabilities ($\beta = 0.62$, $p < 0.001$), but a direct non-significant effect on operational marketing capabilities ($\beta = -0.05$, $p = 0.76$). In addition, its indirect effect on this last variable was also positive and statistically significant ($\beta = 0.28$, $p <0.001$). Taken together, these results suggest that the positive effects of the availability of BI&A resources and capabilities on a company’s operational marketing capabilities are fully realized through its positive impact on the development of dynamic capabilities. Thus, we obtained empirical support for the total mediation hypothesis defined in H3.
Discussion and Conclusion

Given the scarcity of empirical research that investigates how investments in BI&A resources and capabilities generate business value, this study makes an important contribution to the scholarly debate on the subject. We further theoretical knowledge on how BI&A technologies can affect business outcomes by developing a causal model based on the Dynamic Capabilities Theory. The model proposes that the availability of BI&A resources (capabilities, structure and operation) in a company can generate positive impacts on its operational capabilities only to the extent that it promotes the development of dynamic capability. It is underpinned by Pavlou and El Sawy's (2011) approach, which breaks down dynamic capabilities into the environment understanding, learning ability, integration, and coordination capabilities. Furthermore, we propose that the positive effect of dynamic capabilities on operational capabilities is intensified by the level of turbulence in a firm’s business environment.

Our statistical analysis, based on data collected from several offices within the retail division of a Brazilian telecommunications multinational, confirmed two of the three proposed hypotheses. Empirical support was obtained for the full mediation of the effect of the availability of BI&A resources and capabilities on marketing operational capabilities by the dynamic capabilities of the firm. In this way, our results suggest that Business Intelligence and Analytics investments tend to leverage marketing operational performance only to the extent that they improve a firm’s ability to understand its business environment, obtain, absorb, disseminate and integrate new knowledge into its existing knowledge base, and develop and reallocate resources and organizational capabilities to respond to market needs. These findings clarify and complement the arguments proposed in the literature (Chen, Chiang and Storey, 2012; Fink, Yogev & Even, 2017; Watson & Wixom, 2007; Wixom, Watson & Werner, 2011; Relich, 2013) by making explicit the role of a company’s dynamic capabilities, promoted by BI&A investments, in the generation of business value at the organizational process level.

The moderation hypothesis included in the proposed model was not empirically supported. Thus, it was not possible to verify that the positive effects of dynamic capabilities on operational capabilities increase proportionally to the level of environmental turbulence. As previously explained, this result may be due to problems in the measurement of turbulence in the Telecom market, as well as to the small sample size we obtained. However, it should be noted that, at the time the data was collected, Brazil was experiencing the greatest economic crisis in its history. The situation had profound impacts on the Telecom industry, creating volatility and uncertainties that were probably more intense than those typically associated with changes in consumption patterns or technologies relevant to the sector. Therefore, it is possible that the
responses collected with the turbulence scale (Pavlou and El Sawy, 2011) have been distorted, thereby affecting the results of our tests.

In an attempt to further explore our data, we used the estimated coefficients to plot the predicted relationship between dynamic capabilities and operational marketing capabilities, at different levels of environmental turbulence. Figure 3 shows the relationships for high (red line) and low (blue line) turbulence. Although, on average, operational marketing capabilities are more developed for higher levels of turbulence, their relationship to dynamic capabilities appears to be lessened compared to that estimated for lower turbulence levels. This suggests that, in more turbulent environments, increases in dynamic capabilities would tend to generate lower gains in operational marketing capabilities than they would do in more stable environments. Indeed, in a context where high levels of volatility and uncertainties in the external environment are associated with major changes in the company’s internal environment, it could be harder to translate better monitoring, learning, coordination, and integration capabilities into more efficient and effective operational processes. This, in fact, occurred in the company where we collected our data.

To respond to the economic crisis that the country was experiencing, the company had been undertaking a series of initiatives to cut costs and optimize resources, including changes in its hierarchical structure and internal processes, workforce layoffs, and outsourcing. Such changes were affecting the various areas of the company to different degrees: those operating in more volatile and uncertain environments (more strongly affected by the economic crisis) tended to face more intense internal changes; those operating in more stable environments (less affected by the crisis) were less affected by the internal changes implemented in the company. In this way, groups that reported higher levels of turbulence would face greater difficulties in transforming increases in dynamic capability into operational marketing capability gains.

![Figure 3: Dynamic capabilities and operational marketing capabilities](image)

Therefore, we suggest that new studies should be conducted to clarify whether the moderating effects predicted in the Dynamic Capability Theory (Helfat et al., 2007; Teece, 2014; Teece, Pisano and Shuen, 1997) materialize in emerging economies in ways that are similar to those in developed countries, where there is certainly greater economic stability. These studies could focus on other sectors of the economy and rely on richer data. For example, in-depth and longitudinal qualitative studies could reveal characteristics of the value creation process related to BI&A that are peculiar to a certain national context. In the case of quantitative research, it would also be important to carry out new assessments of the measurement scales of the constructs, especially for environmental turbulence.

From the managerial point of view, the study contributes to elucidate how BI&A investments can generate business value. This is important in the current scenario, where BI&A resources and capabilities have become critical to business strategy and require more frequent investments. Such needs are sometimes difficult to defend in the corporate environment, since many of the benefits of adopting BI&A solutions are considered intangible. We have obtained data that empirically supports the pathways through which investments in BI&A generate business value, therefore providing arguments to inform the decision-making processes associated with such initiatives. The results presented here suggest, for example, that to evaluate the benefits that a company has obtained using BI&A, one must begin by analyzing the company’s...
capability to monitor their external environment, to obtain, internalize and share new knowledge, and to coordinate the development and reallocation of organizational resources and capabilities. The mediating role of dynamic capabilities, which was proposed and verified in this research, indicates that improvements on its component capabilities should precede improvements in a company’s operational capabilities. This way, the evaluation of BI&A return on investment may be affected by the lag between the introduction of new BI&A systems and the generation of value for the business (Trieu, 2017). In addition, the model proposed in this study indicates where one’s focus should be when assessing a BI&A project’s results; namely, the dimensions of a company’s dynamic capabilities and operational capabilities that contribute to organizational performance. Different performance indicators may be used as outcomes. Simultaneously, and complementarily, companies should map changes in operational processes that have been leveraged by more and better information and capabilities provided by new BI&A resources.

Furthermore, we suggest that future studies expand the scope of the model we proposed, since the relationship between BI&A investments and organizational performance has not yet been fully clarified. To this end, we suggest that researchers consider the different aspects of performance (e.g., achievement of goals, customer and stakeholder satisfaction, financial and operating results). As already mentioned, researchers can conduct longitudinal, qualitative studies, as well as quantitative studies with measurement scales validated in the context of emerging economies. In both cases, we recommend that special attention be given to operational marketing capabilities, which have important influence on the achievement of business objectives and competitiveness (Cavusgil, Seggie and Talay, 2007; Homburg, Grozdanovic and Klarmann, 2007; Al., 2005). This will contribute not only to better understanding the benefits of Business Intelligence and Analytics systems, but also expand scientific knowledge on the generation of value related with the introduction of information technologies in organizations – a gap that remains in the IS literature (Peffers and Santos, 2013, Sabherwal and Jeyaraj, 2015, Schryen, 2013).

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