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Are clients assisted an outstanding variable to analyze the Product Life Cycle?

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Abstract
The forecasts about the behaviour of the Product Life Cycle (PLC) have been done by the Bass Model. The main contribution of this investigation is to propose the use of the clients assisted variable in the face of sales variable. Its main target is to analyze which variable is the most useful to calculate the stages of the PLC through Bass model, proposing a new way to manage marketing and sales departments in companies. In this investigation 223.557 clients assisted were analyzed nationwide by an automobile network dealer, 36.819 of them purchased cars during 24 months, which was the period of the study. In this analysis, the Bass model and non linear regression models were applied to define the stages of the product life cycle. The results show that we can get more consistent estimations of the product life cycle thanks to clients assisted variable. This study has theoretical and practical implications that can help enterprise management.

Key words
Bass model, time series, life product cycle, consumer behavior, automotive.

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The main methodological contribution is the use of the clients assisted variable in the Bass Model

1. Introduction

Companies analyze the product life cycle (PLC) to predict variations in the product marketing process, consumer behavior and the adaptation to changes that occur in the environment and in the competition. These changes condition the design of the marketing strategy; knowledge of market behavior can thus contribute to reducing the level of uncertainty and improve marketing decisions (Briede-Westermeyer, Cabello-Mora, Pacheco-Blanco & Cartes-Sanhueza, 2016). In this sense, Miquel & Mollá (1982) indicate that "recognition of the existence of the PLC highlights the need for product innovation by companies. In doing so, an important element as a basis for planning the innovation strategy within a company is the positioning of their products with reference to the PLC and how this takes shape."

The PLC analysis is extremely important for companies, since it enables them to be prepared and to use the forecast as a tool to strategically plan investments in innovation and marketing, thus making their knowledge and development a scientific challenge in the coming years. Saffo (2007) supports this position, stating that "the art of forecasting lies in identifying an S curve when it starts to emerge, long before its turning point." Furthermore, it has been demonstrated (Qualls, Olshavsky & Michaels, 1981; Gan, Pujawan, Suparno & Widodo, 2015) that the sales performance of the most recent innovations shows a progressive shortening of the duration of the life cycle, particularly during the introduction and product growth stages.

Different authors (Aguilar, Ávalos, Giraldo, Quintero, Zartha & Cortés, 2012; Rink & Swan, 1979; Fu, 2009) indicate that the PLC stages act differently from the customary "S" model so widely used in the literature. Sales, which are currently the performance parameter commonly used for PLC analysis, may not be the most consistent variable because they are affected by certain economic phenomena, such as general price increases in the economy (inflation), or by variations in relative prices (certain products compared to others). Spain is one of the OECD member countries in which the available income is noticeably affected by redistributive tax policies, particularly in expansionary times when these take on a strong social component (Camacho & Galiano, 2009).

The aim of this article is to study the behavior of the life cycle of a consumer durable goods product in the Spanish market. It delves deeper into the analysis of the PLC, distinguishing between the variables "Clients assisted" and "Sales" in order to develop a business decision-making methodology that makes it possible to discriminate between the use of the two variables. We believe that this is the basis for the foundation and gives importance to the research conducted in this document, the originality of the use of the clients assisted variable, which suggests a new line of research. The main methodological contribution is the use of clients assisted in the Bass Model, since historically the variable of sales has commonly been used, thus obviating the use of other variables without any previous study that would make it possible to highlight the use of this variable.

This has led us to pose the following question in this research: Can the clients assisted variable constitute an efficient and consistent replacement for the sales variable in order to estimate the PLC?

2. Theoretical framework

2.1. Product life cycle

In this article, we have conducted a thorough review of the literature on PLC and the Bass Model (which plays a predominant role in dating the stages of the PLC) and we have

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repeatedly found that the articles refer to the number of sales as the sole variable for conducting the analyses. The most relevant articles reviewed that have used the sales variable for the PLC analysis and the Bass Model are summarized in Table 1.

Table 1
Summary of the review of the theoretical framework for using the sales variable for the analysis of the PLC and the Bass Model

Variable used	Scope of application	Research objective	Limitations of the study	Sources
Sales	The sales of 314 industrial vendors	New product launches	First years of the product launch	Fu (2009)
Sales	Sales of technology products	PLC forecast model	This research uses historical data	Orbach & Fruchter (2014)
Sales	Sales of 29 brands	Introduction in new markets	Shallow depth of the product PLC	Shankar, Carpenter & Krishnamurthi (1999)
Sales	Sales of new products and the PLC	PLC analysis	No benefits defined in the relationship between the two variables	Suomala (2004)
Sales and price	The evolution of sales and price	PLC analysis	Supply and demand behavior	Kaldasch (2015)
Sales	Sales analysis of eight products in nine countries	PLC analysis	Analyzes durable goods	Palacios (2013)
Sales	Purchasing intention of potential customers	New product launches	Lack of analysis of purchasing decisions	Briede- Westermeyer et al. (2016)
Sales	Sales of three products	PLC analysis	Lack of customary influence	Ratcliff & Doshi (2016)
Sales	Evolution of sales over time	New product launches	Lack of analysis of market size	Cetinkaya & Thiele (2016)
Sales	General Electric sales	Conversion rate	Analyzes sales in a market	Ledingam, Kovac & Simon (2006)
Sales	Sales of mobile phones and Internet access	Communications sector and the digital economy	Lack of adoption patterns among countries	Weissmann (2008)
Sales	Sales in the electricity market	PLC analysis	Lack of business implications	Hachula & Schmeidel (2016)
Sales	Fatigue analysis of customers regarding the product	PLC analysis	Homogeneous population Cross sales not considered	Wu, Wang & Li (2015)
Sales	Apparent consumption	Analysis of the behavior of the life cycle of durable consumer goods	Estimated sales due to the lack of data	Polo (1983)
Sales	Sales to define the real diffusion curve	Analysis of the diffusion of sales in several countries	Poor model fit in some countries	Zhu, Tokimatsu & Matsumoto (2017)
Sales	Sales in product units from the industrial sector	Measurement of the product life cycle	Influence of the macroeconomic variables on sales	Aguilar et al. (2012)
Sales	Theoretical approach to the PLC	Convergence between chaos theory and the PLC	Sensitivity of the sales curve using the PLC	Rodríguez Escudero (1996)
Sales	Sales and inventory management simulations	Fashion product demand forecasting based on the Bass and Newsvendor models	Use of theoretical models	Spragg (2017)

The Bass Model has been developed fundamentally to estimate the stages of the PLC and to forecast the diffusion of innovation in the durable goods markets

The PLC has been historically defined as the evolution in the sales of a product during the time that it remains on the market (Levitt, 1981). Some works, although few in number, mention the use of other variables. Two such examples are the work by Lambkin & Day (1989), based on the analysis of the competitive context and the evolution of competition (supply factors) and that by Aguilar et al. (2012), which indicates the importance for companies to use other measurement variables.

2.2. Bass Model: origin and benefits

The Bass Model has been developed fundamentally to estimate the stages of the PLC and to predict the diffusion of the innovation in the durable goods markets (Cetinkaya & Thiele, 2016). This model considers that sales of a new product at any given time depend on the probability of conversion of the "innovators" and the influence they have on the "imitators" (Santesmases, 2012): first is the fast wave resulting from the spontaneous purchase by the potential adopters (innovators) with the innovation rate; second is the slow wave that spreads throughout the market, triggered by social learning, where the number of adopters increases with the rate of imitation (Kaldasch, 2015). The adoption of a product is the point at which a new product is introduced in a market. Once the new product is adopted, the diffusion pattern is formed. These two terms can be understood as the breadth and depth of a product in different countries (Palacios, 2013). For the correct application of the Bass Model, first we must consider the speed with which customers adopt the new innovation and second, whether the company has the right capacities and sufficient organizational capacity to manage this growth (Ratcliff & Doshi, 2016).

Table 2 below lists the main authors and their contributions that make up the theoretical framework used in this research.

Table 2
Summary of the theoretical framework used in the research

Research objective	Methodology	Conclusions	Source
		Bass Model	
Analysis of the product life cycle	Chaos theory	Implications for dynamic product management	Rodríguez Escudero (1996)
	Bass and Mansfield models	Diffusion and adoption of new products in Latin America	Palacios (2013)
	Bass Model	The Bass innovation-diffusion model has shown a satisfactory fit with sales evolution data over time	Polo (1983)
	Bass Model	The PLC behaves regularly in homogeneous goods markets	Kaldasch (2015)
	Bass Model	Use of the Bass Model to analyze the diffusion of new products	Ratcliff & Doshi (2016)
	Bass Model: analysis of feature fatigue	The evolution of sales can be used to analyze the characteristics that must be added to the product to reduce the feature fatigue of the products	Wu et al. (2015)
		Product life cycle	
Product life cycle measurement	Logistic model of demographic growth	Knowledge of the points of inflection for strategic decision-making	Aguilar et al. (2012)
Product life cycle	Process management	Project management model proposal	Ferreira, Faria, Azevedo & Marques (2017)
	Mathematical model	Mathematical model proposal	Hachula & Schmeidel (2016)
	Qualitative	Positioning strategies proposal	Moon (2005)
Study of product innovation and its effects on the life cycle	Review of the literature	Proposal for a typology of the different types of innovations	Miquel & Mollá (1982)

Table 2 (continued)
Summary of the theoretical framework used in the research

Bibliographical review of the product life cycle	Qualitative-type inductive-analytic research method	ESVIPROMER model proposal	Peralta, Cervantes, Olivares & Salazar (2014)
Review of the usefulness of the product life cycle today	Review of the literature	The PLC represents highly valuable information for decision-making in marketing; however, the forecasting capacity for sales has limitations	Muñiz Ferrer (2008)
Studies on the product life cycle	Review of the literature	Twelve different types of PLC can be found, with the classic form being the most common	Rink & Swan (1979)
Analysis of the product life cycle	Chaos theory	Implications for dynamic product management	Rodríguez Escudero (1996)
	Review of the literature	Proposal of different marketing techniques according to each of the stages of the PLC	Suomala (2004)
PLC pattern prediction model	Parametric model	This model is capable of explaining PLC patterns that could not be explained before	Orbach & Fruchter (2014)
	Dynamic system model	Improves the performance of the innovation in the PLC stages	Zou, Guo & Guo (2016)
Introduction in new markets	Dynamic model	Advantages of access to new markets when the product is in an upstream stage of PLC	Shankar et al. (1999)
Theoretical problems			
New product launches	Growth curve model	The age and experience of sellers can determine the success of new products	Fu (2009)
	Expanded model for conceptual design	Improves communication with stakeholders (client, user and expert)	Briede- Westermeyer et al. (2016)
	Price-time sensitivity model	Advantages of applying suitable pricing policies in the PLC stages	Gan et al. (2015)
	Bass Model	Reduction of uncertainty in the launching of new products	Cetinkaya & Thiele (2016)
Conversion rate	Recompilation	The application of scientific methods in sales management increases prospects and the conversion rate	Ledingam et al. (2006)
Applied uses of the Bass Model			
Tourism sector	Estimation of the tourism demand	New focus on estimating the tourism demand based on the diffusion methodology applied to information from tourists who have visited a site	Ayaviri, Quispe & Sánchez (2017)
Automotive sector	Estimation of the diffusion curve in different countries	The effectiveness of the proposed model to estimate the diffusion curve varies according to the country	Zhu, Tokimatsu & Matsumoto (2017)
Textile sector	Prediction of the seasonal demand for fashion	Analytical use of the Bass Model with the Newsvendor model within the context of fashion No data on real-world sales are available	Spragg (2017)
Communications and digital economy sector	Introduction of the heterogeneity of individuals in the Bass Model estimate	Differences in the Bass Model estimate according to the age and education of individuals	Alonso & Arellano (2015)
	Diffusion of new technologies and estimation of demand for new products	Determination of diffusion patterns for new technologies	Weissmann (2008)
	New technological diffusion model	The Bass Model presents fit problems when applied to the Internet sector	López, Orero & Arroyo (2007)

The analysis of the PLC is expanded, distinguishing between the clients assisted and sales variables, for the purpose of discovering which of the two variables is more useful for calculating the stages of the PLC using the Bass Model

In this context, the present article aims to contribute to the joint research on commercial and marketing management from both a theoretical and practical perspective, analyzing the PLC in greater depth, distinguishing between the variable of clients assisted and sales, in order to discover which of the two variables is the most useful for calculating the stages of the PLC using the Bass Model. With this purpose in mind, this research proposes the following hypothesis:

H1 The clients assisted variable provides more efficient and more consistent results for estimating the Product Life Cycle than the sales variable.

3. Methodology

3.1. The econometric model

In order to conduct this research, the Bass Model has been developed based on the distribution function *F(t),* which represents the adoption of the period *t,* and its related density function *f(t)*. Based on them, following a hazard rate, the probability of being an adopter is defined among those who have still not done so at moment *t* as $\frac{f(t)}{1-F(t)}$, which is defined linearly as shown in equation 1.

$$\frac{f(t)}{1 - F(t)} = p + q \cdot F(t) \qquad (1)$$

where *p* is the innovation coefficient and *q* is the imitation coefficient. Thus $p, q \in (0,1)$, in which the following conditions must be met: $p < q$ and $(p + q) < 1$. Said parameters are also known as external and internal influence coefficients, respectively. The model thus represents a modeling of combined influences (external and internal).

The first estimation method used, according to Schmittlein & Mahajan (1982), is the direct estimation by non-linear methods of the solution reached when solving the differential equation, whose solution for *f(t)* is shown in equation 2.

$$f(t) = \frac{\left(\frac{p+q}{p}\right)^2 \cdot e^{-(p+q)t}}{\left[1 + \frac{q}{p} \cdot e^{-(p+q)t}\right]^2} \qquad (2)$$

The result of this estimation is obtained through non-linear methods; specifically, a non-linear estimation using ordinary least squares (OLS) in the defined equation. The estimation of this function enables us to directly obtain the estimate of the parameters *p, q* and *m* and from them, estimate *f(t),* the representation of which allows us to draw the density function previously introduced by the Bass Model. Applying the non-linear methodology, the coefficients estimated by MCO will be used as a starting point in the iterations.

The data were collected during a 24-month study period between August 2014 and July 2016

3.2. Sources of information and data

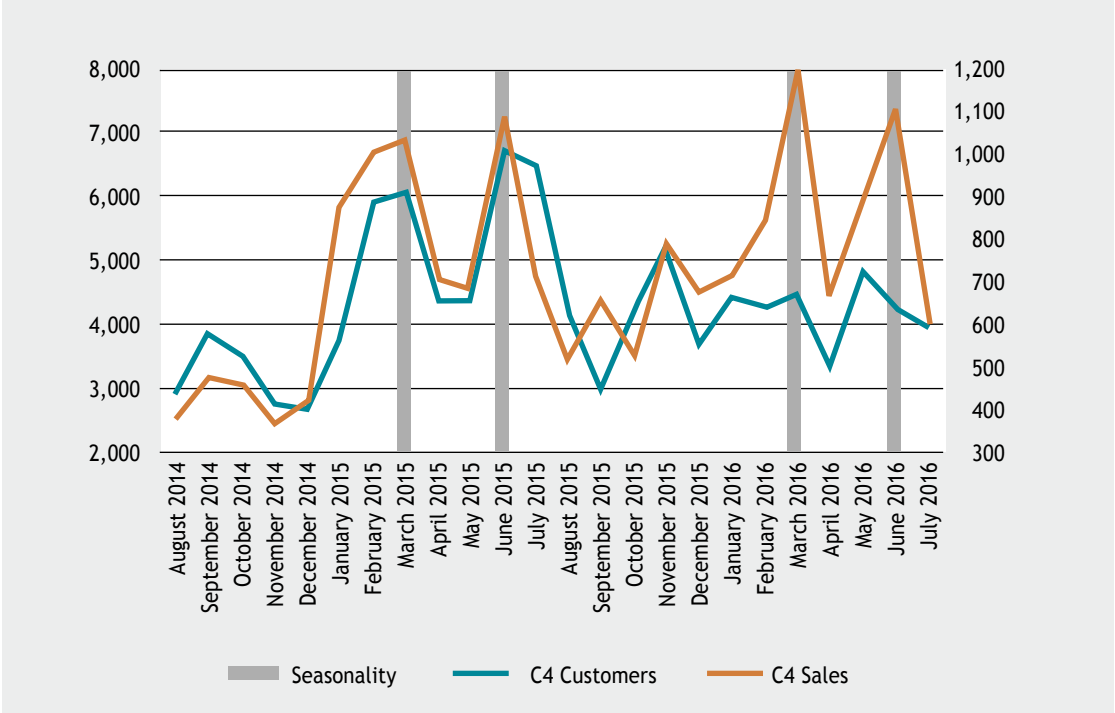
The data used in this study were provided by the company Automóviles Citroën España. The models analyzed (C3 and C4 Cactus) are two models that are considered to be substitutes, which makes the research more relevant, since the changes in the volume of clients assisted and/or the sales of both models cannot be attributed to the variation in customer behavior. Furthermore, it must be kept in mind that both models represent an important percentage of sales for the manufacturer.

The C3 is a model that has been very well received in the market over the years that it has been sold, and continues that way even today. Throughout the entire period, it has had a mean value of 4,925 clients assisted per month. It is therefore expected to be found throughout the analyzed period in the mature stage of the product.

The C4 Cactus model was launched in August 2014, when we started the data collection. Two clear trends are observed in its evolution, corresponding to the introduction and growth (first trend evidencing strong growth until August 2015, with a growth rate of 3%) and the maturity of the product in the market (where maintenance in the market is observed, with a value for clients assisted oscillating around a mean value of 4,148 units).

On the other hand, it must be pointed out that the units of observation were recorded on a national level and were gathered from the entire network of Citroën Spain car dealerships, which consist of 140 dealerships located throughout the entire country. The data (see Table 3) were collected during a 24-month study period, which lasted from August 2014 to July 2016. Said period coincides with the entry into the market of a new model, the C4 Cactus, and the continuity in the market for an older model, the C3.

Table 3
Representation of the seasonality of the sales and clients assisted variables



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This research represents and interesting scientific challenge, since the 24-month analysis enables us to discover the behavior and dating of each of the stages in the life cycle of a capital good, such as the automobile

Two types of variables are considered:

1. Number of clients assisted (customer prospects) per dealer and the total for the network of dealerships, as defined by their interest in the C3 and/or C4 Cactus car models in a network of car dealerships.
2. Number of sales per dealer and total sales for the network of dealerships.

The number of observations is 223,577 clients assisted, who purchased a total of 36,819 units of the C3 and C4 Cactus models (sales) at the points of sales during the study period.

As a result of all of the above, this research represents an interesting scientific challenge, since through this 24-month analysis, we are able to discover the behavior and dates of each of the stages of the life cycle of a capital good such as an automobile, which belongs to the automobile industry, an area of paramount importance in the Spanish economy (Rodríguez, Olarte & Saco, 2015).

3.3. Analysis strategy

In order to analyze the different behaviors from different stages of the life cycle of both products, the analysis period is divided into the following sub-periods, based on the behavior of the C3 and C4 Cactus models defined in the previous section:

- From August 2014 to March 2015: this is the launch period for the C4 Cactus and the maturity stage of the C3.
- From April 2015 to August 2015: this is the growth period for the C4 Cactus and the maturity stage of the C3.
- From September 2015 to July 2016: during this period, both models were in their maturity stage.

From these sub-periods on, we consider three types of analysis to meet the previously defined objectives:

- Analysis 1: to analyze the behavior of the entire period, from August 2014 to July 2016, for the C3 and C4 Cactus models so that the analysis can reveal whether there are different behaviors as the result of being in different stages of the PLC.

- Analysis 2: to analyze the behavior of the C4 Cactus during the periods August 2014 to March 2015, April 2015 to August 2015 and September 2015 to July 2016. The objective of this study is to see whether the results of this research are consistent with those found in the PLC literature.

- Analysis 3: to compare the results of the C3 between August 2014 and March 2015 and between April 2015 and August 2015 with those of the C4 Cactus. If the results of this analysis are different, this would demonstrate that they are in different stages of the PLC.

4. Results

As previously mentioned, for each type of product (C3 and C4 Cactus) and for the study periods defined in the previous section, innovation *(p)* and imitation *(q)* coefficients will be estimated using MCO and MCNL. The results obtained by MCO for the parameters β_0, β_1 and β_2 do not allow consistent estimates to be obtained for p and q, given the restrictions that the values of these parameters must meet: they are contained in the interval (0,1) and the sum of

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The clients assisted variable obtains a better fit and greater consistency in the results in the estimation of the analyzed period

the two must be less than one. Most of the estimates do not meet these restrictions. Just the opposite is the estimate of the *p* and *q* obtained by MCNL, which provides results that meet the aforementioned restrictions.

4.1. Comparison of the behavior of both models throughout the entire period (analysis 1)

Table 4 shows estimates of *p* and *q* obtained for the two products throughout the entire analysis period, from August 2014 to July 2016, differentiating between the estimates made based on the clients assisted and sales variables.

Table 4
MCNL estimate for the entire period (from August 2014 to July 2016)

	Innovation coefficient (p)	Imitation coefficient (q)	R^2 of the model
Clients assisted			
C4 Cactus	0.0223***	0.0995***	0.963
C3	0.0098	0.0213	0.983
Sales			
C4 Cactus	0.0147**	0.0647*	0.925
C3[1]	0.0001***	0.0086	0.955

[1] Converges after reaching a high number of iterations and does not reach the value for the model constant *(m)*. The significance of the estimated parameters is displayed next to each estimate: *** < 1%; ** 1-5%; * < 5-10%.

For both variables and both models of vehicles, it is observed that the estimates for the innovation coefficient parameter *(p)* are lower than for the imitation coefficient *(q)*. On the other hand, the estimates show that the innovation coefficient of innovation of the C4 Cactus is greater than that of the C3, for both the clients assisted variable and the sales variable. The imitation coefficient *(q)* is also greater, which indicates that the C4 has a larger imitation coefficient as compared with both itself and the other vehicle model (the C3). Furthermore, this result is significant at 1%, although this only occurs for the clients assisted variable (at 10% for the sales variable), which shows a better fit (with a coefficient of determination of 0.96 as compared to 0.92 for the sales variable). The fact that a greater imitation coefficient *(q)* is obtained for the C4 Cactus indicates that this is a vehicle model in a growth stage, as compared to behavior of the C3.

From the previous analysis, it can be concluded that the clients assisted variable obtains a better fit and greater consistency in the results on the estimation of the analyzed period. This reveals that the clients assisted variable provides more reliable results than the sales variable. These results show that the behavior of the C3 and C4 Cactus models is different over the period of time studied and therefore it can be inferred that they are in different stages of the PLC.

4.2. Comparison of the behavior of the C4 Cactus throughout the different sub-periods (analysis 2)

Table 5 shows the *p* and *q* estimates obtained for the C4 Cactus for the different sub-periods justified above.

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For the estimation of each of the stages of the PLC, the clients assisted variable is more efficient and more consistent than the sales variable for the behavior of the C4 Cactus model

Table 5
MCNL estimate for the C4 Cactus, differentiating among three sub-periods

	Innovation coefficient (p)	Imitation coefficient (q)	R^2 of the model
Clients assisted			
August 2014 - March 2015	0.0287	0.1466	0.954
April 2015 - August 2015[1]	0.0014	0.5523	0.975
September 2015 - July 2016	No convergence		
Sales			
Fails to converge for any of the sub-periods			

[1] The convergence value is reached with B0 = cumulative period value. The significance of the estimated parameters is displayed next to each estimate: *** < 1%; ** 1-5%; * < 5-10%.

Compared to the previous analysis (Analysis 1 presented in Section 4.1), in this analysis it should first be noted that the model does not converge for the sales variable in any of the sub-periods analyzed. This should be understood as a deficiency of that variable to provide estimate results for the Bass Model (convergence is reached for random values, which shows the lack of consistency in the model fit based on this variable). This provides support for the previous analysis, which showed that the sales variable presented a poorer fit. This demonstrates that, for the estimation of each of the stages of the PLC, the clients assisted variable is more efficient and more consistent than the sales variable for the behavior of the C4 Cactus model. This statement reveals a contribution to previous scientific literature and represents an important new line of scientific research.

With regard to the clients assisted variable, in spite of the fact that the results do not produce significant estimates, it is observed that the innovation coefficient *(p)* decreases once past the introduction stage (August 2014 - March 2015) and entering the growth stage (April 2015 - August 2015), while the imitation coefficient shows the opposite evolution: an increase between the introduction stage and the growth phase.

A greater imitation coefficient *(q)* is obtained in period 2 (April 2015 - August 2015), which corroborates the fact that this period must be treated as a PLC growth stage. In addition, the results of both the introduction and growth stages are significantly different for every level of significance (and thus we must reject the parameter equality hypothesis). However, and while the results can be interpreted, they are not significant for any of the customary levels of significance.

In light of the results presented here, we may question whether, by choosing the clients assisted variable, based on the estimates presented, we are giving priority to the analytical tool over the business objective. In this regard, it is true that beyond the fact that the clients assisted variable correctly fits the Bass Model, the authors must consider whether this variable is useful for making success predictions or for the future evolution of the product. To this end, the researchers made a six-month prediction using both variables for the C4 Cactus model (since this model covers the different stages in the same cycle), using in both cases a first-order moving average time series model. This model proved to be the one that best represented the behavior of both variables. The results obtained show that the measurement and goodness of

The authors propose the use of the clients assisted variable over the sales variable for the analysis of the PLC

fit statistics for the prediction made provide similar results with both variables, producing a Theil's U statistic of 0.87 in the case of the clients assisted variable and 0.89 for the sales variable. While these results and their proximity to 1 show a prediction that is not very useful, since it does not contribute anything more than the use of the criterion $P_{t+1} = X_t$, they reveal that neither variable is identified as better than the other as a predictive tool. Therefore, the authors logically believe that both variables are equally useful for forecasting.

As a result of everything indicated in this article, it can be stated that the clients assisted variable is more functional and effective than the sales variable for the following reasons:

- The forecasts obtained from both variables (clients assisted and sales) fail to reveal that one variable is any better than the other.
- The ease in recording and monitoring the clients assisted variable is the same as for the sales variable.
- However, the sales are affected by macroeconomic phenomena that negatively affect its usefulness as a reference variable for the analysis of the PLC. This aspect advises against the use of sales as the sole aspect for evaluating the business success of a product.
- Furthermore, it has already been indicated that, over the short term, sales are a more seasonal variable than the clients assisted variable, since the purchase itself is linked to certain times of the year, such as the months of March and June.

In short, the authors propose the use of the clients assisted variable over the sales variable for the analysis of the PLC for the following reasons:

- The clients assisted variable better fits our Bass Model.
- It is a variable that is equally effective for forecasting.
- The data for both variables are equally easy to obtain by companies.
- The clients assisted variable is unaffected by macroeconomic phenomena and its seasonality is lower than for the sales variable.

4.3. Comparison of the behavior of the C3 throughout the different sub-periods (analysis 3)

Table 6 shows the previous analysis, but only for the case of the C3 model. Just the opposite of what occurred in the analysis of the C4, the results for the different sub-periods are all

Table 6
MCNL estimate for the C3, differentiating among three sub-periods

	Innovation coefficient (p)	Imitation coefficient (q)	R^2 of the model
Clients assisted (C3)			
August 2014 - March 2015	0.0755***	0.1814**	0.99
April 2015 - August 2015	0.0118***	0.1330***	0.99
Sales (C3)			
August 2014 - March 2015	0.0783***	0.2922**	0.97
April 2015 - August 2015	0.0113***	0.1232**	0.96

The significance of the estimated parameters is displayed next to each estimate: *** <1%; ** 1-5%; *<5-10%.

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significant at the 5% and 1% level for the C3, regardless of whether the clients assisted or the sales variable is used. However, if we consider the regression fit, once again the results obtained for the C3 model reinforce those obtained for the C4 Cactus model in terms of the greater efficiency of the clients assisted variable. The result of this analysis is the discovery that, for the estimation of each of the stages of the PLC, the clients assisted variable is more efficient and more consistent than the sales variable for the behavior of the C3 model, as occurred in analysis 2 for the C4 Cactus model. This statement reinforces the results of Analysis 2 and reveals discrepancies with the previous scientific literature, reinforcing this interesting new line of scientific research.

The results for the C3 show that the criterion that the innovation coefficient *(p)* is lower than the imitation coefficient *(q)* is once again met. Furthermore, the hypothesis that the results of the values produced by the imitation coefficient are equal is not rejected, and thus no difference is observed between the two stages.

If the results are compared to those obtained in the analysis of the C4 Cactus, we see that in the period April 2015 - August 2015 the *q* value is significantly greater than that obtained for the C3, which reinforces the evidence that the C4 is in a growth stage in which the C3 is not.

5. Conclusion

This work opts to use the clients assisted variable for the PLC analysis for the purpose of evaluating its usefulness in the Bass Model and its usefulness in dating the life cycle stages of a product (PLC) for durable goods, as compared to the sales variable commonly used in the existing literature.

This article is in line with the results obtained in previous works, such as those by Rodríguez Escudero (1996), Aguilar et al. (2012), Muñiz Ferrer (2008) and Mahajan & Muller (1979), which propose that the sales variable is not the best measurement parameter, as it is affected by economic and sociodemographic variables. These authors indicate the lack of usefulness of forecasts based on this variable over the long-term, when used for PLC analysis, given the extreme sensitivity of the sales curve to the initial conditions.

The bibliography reviewed in this research proposes that the knowledge of the stages of the PLC is a relevant challenge within the business strategy (Shankar et al., 1999; Rink & Swan, 1979; Palacios, 2013). Likewise, this knowledge of the PLC stages makes it possible to improve product-price positioning, as well as improving the effectiveness of marketing strategies in companies (Kaldasch, 2015; Moon, 2005). There is a broad consensus on the part of different authors on the need to take into account the PLC when determining the marketing strategies that must be followed. As explained in this empirical work, the main differences among the authors who defend the usefulness of the PLC and those who are critical of its use in business practice lie in the accuracy of the forecasting capacity of the sales for the PLC analysis (Muñiz Ferrer, 2008). This power to forecast the future could be implemented with the use of the clients assisted variable in the future, as shown in this article.

This statement is in line with the previous articles such as that by Camacho and Galiano (2009) who indicate that sales, which are currently the performance parameter commonly used for PLC analysis, may not be the most consistent variable because they are affected by certain economic phenomena, such as general price increases in the economy (inflation), or by variations in relative prices (certain products compared to others).

Sales are a more seasonal variable than the clients assisted variable, since the purchase itself is linked to certain times of the year

In the field of marketing and sales strategies, the analysis and duration of the PLC stages is relevant. The authors propose comparing the use of two variables in the dating of the PLC: sales and clients assisted in the Bass Model. This article also establishes the dates for and shows the stage or stages in which two specific products are found within the Spanish automobile sector: the Citroën C3 and the C4 Cactus. Both vehicles have been analyzed to consider the acceptance of both models during the study period (Rodríguez, Olarte-Pascual & Saco, 2017) and therefore the acceptance of the models cannot be considered a distorting factor affecting the research results.

The results obtained based on a strategy of analysis that follows three differentiated steps in time are as follows:

- Analysis 1 shows that the complete period of study, from August 2014 to July 2016, indicates that the C3 and C4 Cactus models are passing through different stages. This fact is also corroborated in the comparative analysis of the strategy 2 and 3. This coincides with the scientific literature. In this research, it has been shown that the clients assisted variable is more efficient for this analysis than the sales variable.

- Analysis 2 reveals that the clients assisted variable proposes results that are more efficient and more consistent for estimating the PLC than the sales variable for the C4 Cactus model. These results represent an interesting new line of research, since they permit a greater and better fit to the PLC than that obtained with the sales variable.

- Analysis 3 reveals that the clients assisted variable proposes results that are more efficient and more consistent for estimating the PLC than the sales variable for the C3 model. In the previous analysis, it is observed that the C4 Cactus is in the growth stage, as it shows a high imitation coefficient that is significantly different from the previous period, which is not the case with the C3. These results offer the possibility for improved control over the effectiveness of the marketing strategies throughout the PLC.

- The estimate by the Bass Method obtains consistent results with analyses 1, 2 and 3 of this research. The conclusion obtained in this study is that the clients assisted variable provides as a result estimates that are more efficient and consistent than those of the sales variable. Therefore, hypothesis 1 of this research is accepted.

Over the short term, sales are a more seasonal variable than the clients assisted variable, since the purchase itself is linked to certain times of the year. It should be noted that both variables are equally easily to obtain. This is due to the fact that companies have records of clients assisted that permit them to know the store traffic and therefore know whether their volume of sales is due to the number of customers who visit the store or to the conversion rate.

The clients assisted variable is an element that is just as easily available to companies as sales data. However, the use of this variable improves the analysis of the PLC, which enables companies to improve their forecasts. The clients assisted variable becomes a tool for strategically planning investments in innovation and marketing, thus reducing uncertainty in business management.

The use of the clients assisted variable is recommended in the field of business for the calculation of the PLC stage because it enables us, first of all, to know the speed with which customers adopt the new innovation, and to determine the behavior and influence of innovators on imitators; and secondly, because it helps those responsible for marketing to

The clients assisted variable becomes a tool for strategically planning investments in innovation and marketing, thus reducing uncertainty in business management

design a communication plan in the most effective manner in terms of determining the objectives, the instruments to be used, the investment in communications in the different stages of the PLC and/or the decision to prolong the maturity stage, to continue to attract new users to the dealership and to create brand preference.

As a final conclusion, the results show that the C3 and C4 Cactus models are in different stages of the PLC, which is consistent with the previous literature. The C4 Cactus model is clearly in a growth stage, in which the greater influence of the imitators is observed, while the C3 behaves differently and does not form part of this stage.

However, what is most noteworthy about this research is having demonstrated the functionality of the clients assisted variable over the sales variable for the Bass Model and thus for estimating the PLC. These results open a new and interesting line of research on which the authors of this article intend to elaborate in future studies.

5.1. Limitations and future lines of research

The main limitation of this research is the lack of prior scientific literature that uses the clients assisted variable in the Bass Model. In any case, the theoretical framework on the Bass Model in the analysis of the PLC is quite limited as compared to other areas of analysis of the product variable (Suomala, 2004).

Another limitation to this article is that this study focuses on analyzing durable consumer goods. This aspect represents a limitation when it comes to extrapolating the results. Therefore, it is recommended to replicate this study in other activity sectors to contrast the results.

The time horizon analyzed can also be considered a limitation, as it does not include the decline and product removal stages, which are quite ephemeral in the automotive sector.

On the other hand, the main lines of research that are opened based on this study are the following:

- Analysis of the PLC, including all its stages.
- Analysis of the behavior of the conversion rate in each of the stages of the PLC.
- Delving deeper into the relationship between investment in communication, clients assisted and the PLC.

6. Declaration of Conflicting Interests

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