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The Product Life Cycle Revisited: An Integrative Review and Research Agenda

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The Product Life Cycle: An Updated Review and Future Research Agenda

Abstract

Purpose: This paper responds to calls in academia for an update of the product lifecycle (PLC). Through a systematic literature review, we provide an updated agenda which aims to advance the PLC concept both in research, teaching, and practice.

Design/Methodology/Approach: We started by surveying 101 marketing academics globally to ascertain whether a PLC update was viewed necessary and beneficial in the marketing community and thereafter conducted citation analysis of marketing research papers and textbooks to ascertain PLC usage. The subsequent literature review methodology was split into two sections. First, 97 empirical articles were reviewed based on an evaluative framework. Second, research pertaining to the PLC determinants were assessed and discussed.

Findings: From the results of our review and primary data from marketing academics, we find that the method of predicting the PLC based on past sales has been largely unsuccessful and perceived as somewhat outdated. However, a new stream of PLC literature is emerging which takes a consumer centric perspective to the PLC and has seen more success at modelling lifecycles in various industries.

Research Limitations/Implications: First, the study outlines the most contemporary and successful methodological approaches to modelling the PLC. Namely, the use of artificial intelligence (AI), big data, demand modelling, and consumer psychological mechanisms. Second, it provides several future research avenues using modern market trends such as sustainability, globalization, digitization, and Covid-19 to push the PLC into the 21st century.

Originality/Value: The PLC has shown to be resolutely popular in management application and education. However, without a continued effort in academic PLC research to update the knowledge around the concept, its use as a productive management tool will likely become outdated. This article provides a necessary and comprehensive literature update resulting in actionable future research and teaching agendas intended to advance the PLC concept into the modern market context.

Keywords: product lifecycle; PLC, strategy; research agenda

Paper Type: Literature Review

1. Introduction

The product lifecycle (PLC) has been a steadfast tool used in practical decision making (Cox, 1967; Levitt, 1965) and marketing education for decades. It contains an implicit structure of a product's time on the market which allows the determination of product strategies depending on the lifecycle stage (Kotler, 2015). The importance and influence of the PLC concept to these domains remain extensive today, as shown by the framework's consistent presence in marketing textbooks over time and in the consistent, if not growing, volume of PLC citations. It appears then, that the PLC is here to stay. However, much academic PLC research was conducted in the 90s and could therefore appear less relevant to today's context, creating a juxtaposition between what is known about the PLC and what is disseminated about it in teaching and research. Therefore, if PLC teaching and research is going to continue to be disseminated, then an update to improve its relevance, managerial applicability, and theoretical contribution is paramount.

To shed further light into the issue and get a better understanding regarding the general academic marketing community's perspective on the PLC's current state in education and research, we surveyed 101 marketing academics globally and carried out a comprehensive content analysis of published marketing textbooks[1] and citation analysis of published PLC articles (Figure 1). The content and citation analyses present a persistent presence of the PLC throughout recent years, indicating that the concept has been, and still is, a key component in today's business and marketing education.

---Figure 1 here---

[1] Marketing textbooks were included in analysis on the basis of having over 1000 Google Scholar citations and being in the general area of marketing and its subdomains. This resulted in 45 textbooks being analyzed. The number of pages that were related to PLC was counted for each textbook. The results showed that this number, on average, is around 1-1.5 pages with a stable trend over time.

With regards to the global academician survey, our sample was diverse in geographical areas covered (Europe: 64%, North America: 34%, Other: 3%), and inclusive in terms of breadth of academic positions (PhD Student: 8.8%, Entry Level Faculty: 35.3%, Associate Professor/Senior Lecturer: 22.5%, Professorial: 33.3%). We specifically asked the marketing academics about their attitudes towards the PLC for research and teaching, and the advantages and disadvantages of the framework.

The survey results reveal that current marketing academics see the PLCs merit both in research and teaching. In research terms, over 90% of academics consider the PLC managerially and theoretically relevant (Figure 2). Over 95% agree the PLC is relevant, interesting, useful, and easy to understand for students in teaching (Figure 3). Academics also perceived greater advantages to the PLC than disadvantages (Figures 4 and 5), with an average of 86.3% agreeing the PLC is parsimonious, simple, managerially applicable, and describes well real-life practice, whereas a relatively smaller proportion (54%) agree the PLC cannot predict what will happen in the future, has inconsistent levels of analysis, cannot be applied to different industries, and cannot offer generalizable conclusions.

In line with the usability marketing academics afford the PLC, we also find that most academics intend to continue using it both in research (57.8%) and teaching (90.2%) (Figures 2 and 3). Most crucially, however, marketing academia appears to agree the PLC is outdated in its current state (72.5%) and warrants greater attention, with 75.2% indicating a critical literature review on the PLC as a valuable future direction. These findings have three key implications. First, we find that marketing academics see merit in the PLC as a marketing tool both in teaching, theory, and practice. Second, that they consequently intend to continue using the PLC both in teaching and research. Third, marketing academia also note that a knowledge vacuum exists between what is known about the PLC and how it is currently used, and as such, that it needs attention and update.

---Figures 2, 3, 4, 5 here---

In response to these calls, the current study aims to provide a foundation for a reinvigoration of the PLC research stream. To understand the best steps forward in any research stream, it is important to first understand its past (Palmatier et al., 2018). As such, we provide a review of extant literature which identifies the PLC's main issues which may have halted its progression as a marketing framework. We then suggest how these issues can be addressed to bring the PLC up to date. By doing so, we offer at least four significant contributions to extant knowledge.

First, our article utilizes evaluative criteria in line with other recent reviews (e.g., Morgan *et al.*, 2019; Paul *et al.*, 2017) to provide an updated and more rigorous overview of the current literature. Despite being highly informative and moving the field forward significantly, existing review articles published on the PLC (e.g., Day, 1981; Rink *et al.*, 1979)[2] are nearly half a century old and employ a narrative review approach. By introducing and implementing a set of relevant evaluative criteria we sampled 97 papers, in comparison to Rink and Swan's (1979) 20 papers and Day's (1981) unspecified number.

Second, the emergence of social media and digital technology; the shift to greater retailer power; the prevalence of multinational corporations; and the rise of the environmentalist movement have all been shown to influence the PLC framework (Bayus, 1994; Bayus, 1992; Stremersch *et al.*, 2010). Thus, by being the first PLC review in 40 years, we contribute by providing a long-awaited update based on the acknowledged importance of literature review papers in the academic field (Palmatier *et al.*, 2018) and the particular need within the PLC domain.

[2] A more recent review by Cao and Folan (2012) has been conducted, however, the main aim of their research was to further the development of the engineering PLC and it was published in an engineering journal. For this reason, it is not viewed as a core PLC literature review in the marketing domain.

Third, the PLC was initially created to be used as a managerial tool (Hofer, 1975). As such, its ability to offer specific managerial recommendations and strategic directions is important (Moon, 2005). This review contributes by creating a comprehensive PLC determinants model, developed from earlier models (Lambkin *et al.*, 1989), which structures determinants (factors that determine the end, beginning, or duration of PLC stages) into meaningful categories and allows for the identification of areas lacking in empirical research, or containing inconsistent empirical results. Thus, the third contribution is the proposal of a PLC determinant framework to structure and generate managerial directions and recommendations for further research into PLC strategies.

Fourth, our recommendations for future research contribute to existing knowledge by providing an actionable roadmap of future research avenues. Specifically, review results show one of the main issues hindering PLC research is the inability for currently applied methods to model the PLC as a predictive framework. As a remedy, we provide three methodological approaches to the PLC (AI and big data, demand modelling, and consumer psychological mechanisms) which, we argue, will increase its predictive power. We also provide several specific research questions which apply the PLC to contemporary marketing trends in order to explicitly pave the way for this updated stream of literature.

2. Review Methodology

The analysis of previous literature took two forms. The first was an analysis of methodological issues related to the PLC framework. These were identified via preliminary search of the PLC literature and published reviews (Cao *et al.*, 2012; Day, 1981; Dhalla *et al.*, 1976; Lambkin *et al.*, 1989; Rink *et al.*, 1979; Tellis *et al.*, 1988; Wood, 1990). From this, nine criteria (further discussed in section 3.1) were used as a framework to form the basis of the review. The full

analysis was carried out primarily by use of the search engine Google Scholar. Keywords used were phrases such as *product life cycle; product growth; product cycle*.

Once this process was exhausted, further studies were mined from reference lists of papers found in the initial search. The procedure concluded in the analysis of 97 empirical papers from a range of peer-reviewed journals. Studies presented in conferences, unreviewed journals or other sources were excluded (cf. Paul *et al.,* 2017). The articles found were mainly in the areas of marketing, management, and economics. Journals of rated three or higher, according to the Academic Journal Guide Rankings (Chartered ABS, 2021), made up 90% of the sample; see Table 1 for a full list of all journals used in the analysis as well as the distribution of each journal according to decade.

As shown in Table 1, the Journal of Marketing contributed the highest number of articles[3]. In total, 131 authors contributed to the 97 articles, with very little overlap. Articles were deemed eligible on four criteria; (1) they were empirical articles investigating the outcome of an independent variable (IV) on a dependent variable (DV), (2) they were published between the years of 1960-2020, (3) they were in peer-reviewed journals, and (4) they either explicitly or implicitly related to the PLC.

Although it is noted that there are several theoretical articles on this topic, we chose only to include empirical studies in this section as its purpose is to review PLC methodologies. Theoretical PLC papers are discussed in depth in later sections. The article analysis begins in 1960 because this is approximately the time when this concept began to be investigated (Rink *et al.*, 1979).

The second framework reviews the determinants of the PLC and its stages. We reviewed the 97 studies in the evaluative framework to identify the articles pertaining to an investigation of PLC determinants specifically. As such, the selection criteria remained

[3] The large number of articles in the Journal of Marketing is partly due to a special edition on the PLC in 1981

consistent. Studies were deemed to examine determinants of the PLC if they investigated the relationship between an IV and a DV of the PLC shape or length at one or all stages. From this, 25 articles were identified and analyzed. Dependent variables used and the frequency of usage were as follows; ROI/ROA/ROE (n=7), unit sales (n=5), market share (n=5), growth hazard (n=3), profit (n=3), and product take-off (n=2).

--- Table 1 here ---

3. Evaluative Framework

3.1. Table of Definitions

The choice of criteria are as follows. First, the centrality of concept denotes the extent to which the PLC is referred to in the study. A central study investigates the PLC or uses the PLC directly in the investigation, whereas a peripheral study implicitly uses the underlying framework of the PLC without explicit reference. Studies relating to the diffusion of innovation (DOI) concept were classified as peripheral to the PLC; although they use a similar shape, they offer a distinct theoretical rationale, and the PLC is not often explicitly referenced.

Second, the categorization of themes was adapted from Cao *et al.* (2012). Their framework was assessed to establish a timeframe of the major thematic aims throughout the decades. For example, it was assumed validation would be more prevalent closer to the introduction of the PLC, whereas modification and usage were more likely investigated once the concept was well established.

Third, previous literature reviews have cited the need for more research of industrial products (Anderson *et al.*, 1984; Rink *et al.*, 1979). The inclusion of the classification of consumer and industrial product type in the framework aims to assess whether this issue has been addressed in more recent articles.

Forth, due to the dynamic nature of the PLC, a longitudinal design has been recommended in previous research (Anderson *et al.*, 1984). The classification of research

design aims to assess whether the propensity for the recommended longitudinal design is apparent in the literature.

Fifth, product aggregation refers to the level of specificity to the product. Typically, in the PLC literature, these are split into class, form, and brand (Rink *et al.*, 1979). However, after a review of the literature, firm-level analysis was added to the evaluative framework since a multitude of studies investigates the PLC from a firm level (e.g., Catry *et al.*, 1974; Karakaya *et al.*, 2007; Wells, 1968).

Finally, the stage of the PLC was analyzed to ascertain whether there is a proclivity in the literature to investigate certain stages more than others. The definition of stages is deliberately vague and theoretical in order to be inclusive of all papers. The stages were coded using Anderson and Zeithaml's (1984) categorization, although this classification in itself is disputable and will be discussed in later sections. Table 2 provides a list of definitions for the criteria used for setting up the evaluative framework and Table 3 provides the framework itself.

--- Tables 2 and 3 here ---

3.2. Results

3.2.1 Data Collection

The evaluative framework found that the majority of PLC studies are longitudinal (66%). Anderson *et al.* (1984) contend that longitudinal research addressing the long-term effects of specific strategies is crucial in understanding the PLC. However, to date, long-term *primary* research in this area has not been undertaken, as illustrated in the fact that 71% of all studies rely on historical data. Therefore, although such data is useful in tracking the success of strategies at the point of data collection, it sheds little light on the long-term effects of these strategies. Such reliance on historical databases has been critiqued previously (Thorelli *et al.*, 1981), leading to the recommendation for the use of primary longitudinal data in future studies.

3.2.2. Theme and Context

Early validation results proved positive for the rigor of the PLC. Several studies found that the life cycle shape was essentially consistent across product categories, although they proposed slight modifications based on the context of each category (Polli *et al.*, 1969; de Kluyver, 1977; Mercer, 1993).

The modification of the PLC has been undertaken from two perspectives. First, the PLC has been modified theoretically in an attempt to address the criticisms waged against it (Enis *et al.*, 1977; Tellis *et al.*, 1981). Second, due to the appealing simplicity of the concept, it has been extended to other areas of the value chain, for example; the international lifecycle (Wells, 1968), the design life cycle (Newcomb *et al.*, 1998), the manufacturing lifecycle (Lau *et al.*, 2000), and the technology lifecycle (Popper *et al.*, 1992).

By far the most researched area of the PLC, is its application to other industries and contexts (82%). Table 4 highlights the variety of industries which the PLC has been applied to. From this and Table 3, it is apparent consumer durables have been investigated most heavily in contrast to Rink *et al.* (1979) who identified twelve consumer non-durable studies and nine consumer durable studies. This shift may be due to the nature of certain types of products lending themselves better to PLC research. However, it has led to a gap in the investigation into certain types of products. For example, FMCG goods, fashion lifecycles, or technology (online) lifecycles.

In all but one time period (1970-1980), industrial products were investigated considerably less than consumer products. This may be based on the inapplicability of the PLC to industrial products due to differences in marketing strategies and lifecycle lengths (Thorelli *et al.*, 1981). It is argued raw materials are more likely to have a longer, more stable lifespans because they are less susceptible to marketing strategies and consumer demand (Thorelli *et al.*, 1981). However, research into industrial product categories has still been conducted, with

interesting results in some cases (e.g., de Kluyver, 1977; Popper *et al.*, 1992). From these studies, it seems clear that the traditional PLC shape falls short in the conceptualization of industrial products and adaptations to specific industries may be needed. Although such work has been carried out to a limited degree, it may still be an area of interest in further research.

--- Table 4 here ---

3.2.3. Product Aggregation

As yet, there is little consensus as to which level of product aggregation bears the closest approximation to the PLC. Certain studies finds that product forms provide the most reliable PLC shape (Polli *et al.*, 1969; Rink *et al.,* 1979), while some argue for product classes (Lambkin *et al*., 1989), and others brands (Enis *et al*., 1977).

Although this debate is still unresolved it is apparent from the evaluative framework that the majority of studies (59%) are investigating the PLC from a product class level. While product class appears to be a good contingency in less obvious cases, due to the influences of strategic differentiation shown in the evolution of the market (Bayus, 1994), the lack of consensus does not need to create a damning issue for the PLC concept. Rather, it may be a point of consideration for authors to understand the characteristics and influence product aggregation may have on the PLC shape and length. It seems unnecessary to identify which level of aggregation has the closest approximation to the PLC shape when the PLC is intended to be used to understand these fluctuations, rather than a prescriptive shape that researchers must seek to find.

3.2.4. Stage and Measurement

Setting aside the DOI literature (introduction and growth stages), the stages are investigated equally frequently. Most take a holistic approach in which an independent variable is tested

throughout all stages of the product's life (e.g., Anderson *et al.*, 1984; Cox, 1967; Thietart *et al.*, 1984) or the shape of the PLC is tested as a whole entity (e.g., Bayus, 1994). However, some stages are tested independently. This is the case commonly with regard to DOI literature, which, by nature, only investigates the introduction and growth stages. Due to the wealth of DOI literature, the maturity and decline stages have been investigated less extensively as independent entities, with some notable exceptions (i.e., extension strategies and replacement cycles). This may provide an opportunity for further research into these stages in order to match the level of understanding achieved in regard to introduction and growth, especially as extending the product's life is often a key aim from a managerial perspective.

The review further found inconsistency in the measurement and categorization of PLC stages, corroborating earlier findings (e.g., Cao *et al.*, 2012; Rink *et al.*, 1979). The stages are measured in several ways depending on the type of data available to the researcher, the purpose of the study, and the aggregation and type of product being investigated (see Table 5).

---- Table 5 here ---

The lack of consensus signifies a lack of clarity between stages, thus creating a consistency problem. This, according to Grantham (1997), limits the PLC's utility as a forecasting tool. Not only does the lack of clarity create issues for forecasting, but it also makes ascertaining the current stage of a product difficult. As argued by Rink et al. (1979), attempting to assign the stage of a product purely on sales information is flawed due to the variations in PLC shapes. However, as shown in the evaluative framework, financial indicators are still being used in most studies (58%), even though it is difficult for researchers to estimate the unit sales increase and length of the PLC using retrospective sales data. Some researchers have sought to remedy the issue by using modelling, identification of early indicators, or pre-test data to predict stage transitions (e.g., Huang *et al.*, 2008; Orbach *et al.*, 2014). The use of

modelling has proven popular, especially in the DOI literature. This may be a more successful method of predicting transitions of PLC stages, as various studies have proven. Bass (1969) found a product growth model that could be used to successfully predict lifecycle development. The method has been used in numerous studies since (e.g., Mahajan *et al.*, 1979; Norton *et al.*, 1987; Srivastava *et al.*, 1985), with varying degrees of success. As indicated by Table 3, the use of modelling methods has remained relatively popular, and may provide a solution to the issue of prediction using retrospective data.

4. Determinants Framework

4.1. Determinants Model

At the inception of the PLC model, greater attention was directed towards finding a PLC shape universal to all product types. Once apparent that a universal shape was pragmatically unrealistic, focus turned to identifying the factors causing variety in the shapes of PLCs across product categories (Rink *et al.*, 1979). In fact, Lambkin *et al.* (1989) argue that the second most important step to understand market evolution, after determining unit of analysis, is to understand the factors effecting the sales trend, thus addressing the issue of determinism enshrined within the model. The causative nature of the PLC can be viewed from two perspectives.

First, the PLC stage can be seen as the variable that determines which strategies are undertaken. However, issues have been raised with this perspective. Primarily, such a viewpoint gives rise to the criticism that the use of the PLC in marketing strategy formulation can create a "self-fulfilling prophecy" (Wood, 1990, p. 151). An example would be the managerial implementation of a divest strategy in the decline stage of the PLC, initiating further decline. Various authors have argued such actions cause products to be discontinued too early when in fact there may be an opportunity for revitalization (Moon, 2005; Wood,

1990). In contrast, contemporary studies have taken the viewpoint that the PLC is in fact the dependent variable; that strategy decisions effect the PLC stages rather than the inverse (Moon, 2005). From this perspective, managers have the power to change the lifecycle of a product and even reverse apparently declining sales trends. Scholars have therefore proposed methods to adapt and extend the PLC to transcend its limitations (Cox, 1967; Enis *et al.*, 1977; Souerwine *et al.*, 1984). Following the latter approach, the continued assessment of determinant research appears paramount in the development of the PLC field, as previously contended (Lambkin *et al.*, 1989; Tellis *et al.*, 1981). Consequently, the following section assesses contemporary research against a previous determinant model to gauge the level of growth in the area.

A well-cited review of PLC determinants by Lambkin *et al.* (1989) concluded with a framework of market evolution and the factors affecting it. The framework splits determinants conceptually into three key areas: the resource environment, supply, and demand, before analyzing current research against this model[4]. Lambkin and Day's (1989) conceptualization provides the basis for our model, however, an updated adaptation can be found in Figure 6. The adaptations to the original Lambkin and Day model are based on an attempt to increase the managerial applicability and contemporary relevance of the model by using more commonly found concepts. For example, the 'resource environment' is now discussed in terms of the macro and microenvironment which are familiar concepts for managers.

---- Figure 6 here ---

The current model (Figure 6) categorizes the PLC determinants into four categories: (1) macroenvironmental factors including PEST (political, economic, social, technological);

[4] The article went on to propose a model based on evolutionary processes, however to maintain the inherent simplicity of the PLC, this aspect will not be elaborated on in the current review.

(2) microenvironmental factors including competitive, industry, and market behavior; (3) supply side factors including strategic choices, tactical choices (4Ps), resources, and capabilities; and (4) demand side factors including consumers (market potential, adoption process, and individual consumer experience).

By organizing the review based on conceptually justified categorizations, this study provides a systematic and focused analysis of the breadth of the PLC research area. In turn, by adapting an existing framework (Lambkin and Day, 1989) and taking note of the resulting recommendations at that time, we are also able to establish the development of later work in addressing the proposed gaps. Therefore, 25 empirical articles were analyzed in relation to the framework in Figure 6. In addition to the empirical work, a table of determinants proposed by non-empirical papers can be found in Appendix 1. Table 6 shows the resulting determinants framework.

---- Table 6 here ---

4.2. Results

4.2.1. Macroenvironment

First, in the assessment of macro-level environmental factors, only two factors have been investigated empirically; governmental mediation and influential bodies. These factors were tested by Lau (2014) who found governmental mediation has a relatively larger impact than influential bodies. The constructs consisted of items relating to governmental mediation and influential bodies. However, when applying the PEST framework, it becomes evident these types of factors are yet to be investigated comprehensively in relation to the PLC. It may be a result of the lack of primary longitudinal research necessary to assess environmental factors. To address such a gap, it may be beneficial to take the approach of work in the global marketing

discipline (e.g., Hultman *et al.*, 2009) to incorporate a comprehensive and managerially relevant understanding of the macroenvironment's influence in future models.

4.2.2. Microenvironment

A similar case can be made for micro-level structures, despite relatively more research compared to the macro-level, the area is far from comprehensive. Various factors including; type of industry, stage of industry, competitive processes, and size of the market are proposed to influence the PLC in conceptual papers (e.g., Day, 1981; Lambkin *et al.*, 1989; Tellis *et al.*, 1981). Similarly, Day (1981) argues younger industries are shown to have slower market penetration due to lack of industry infrastructure and slower diffusion rates. However, to date, little progress has been made in addressing these determinants, which are often controlled for in studies but not explicitly tested. Thus, we support Lambkin and Day's (1989) earlier findings and continue to recommend to empirically investigate the effect of the industry, the market, and competitive behavior on a product's success over the PLC stages. Again, a useful operationalization of these concepts can be found in the global marketing literature (e.g., Hultman *et al.,* 2009).

4.2.3. Supply

There are several studies investigating the effect of the marketing mix on the PLC. When taking the perspective that firms can actively regulate the PLC through their strategies, it seems natural these require the most attention. However, as shown in Table 6, the level of attention received is not distributed evenly, with product factors generating many more studies than promotion, price, and distribution respectively. Distribution, in particular, requires further investigation to understand how supply-chain decisions can affect the duration and success of each PLC stage, as has been proposed in earlier, non-empirical studies (see Appendix 1).

In relation to product studies, the relationship between product quality and success over the PLC stages has been investigated extensively, and consensus of the positive relationship between these variables in all stages seems to have been reached. However, the relationship pattern is weaker in relation to quality of services, which was only positively related to market share in two stages, with no significant relationship to ROI (Anderson *et al.*, 1984). As the investigation into both products and services was carried out in the same study, it is likely this disparity may be a result of the IV. Currently, investigation into the effect of services on the PLC is limited (Avlonitis *et al.*, 2005; Cohen *et al.*, 1997; Peng *et al.*, 2020). Therefore, it may be prudent to further investigate this relationship.

Regarding price, the relationship between price and product success is debated both in the current review results and in wider literature (Hall, 1980). Price cutting has been recommended as a viable tactic in all four stages by two studies (Golder *et al.*, 1997; Thietart *et al.*, 1984) with the justification that a lower price will represent a competitive advantage and therefore increase product sales. Golder *et al.* (1997) found that a lower price increases the market penetration of a product, thus representing success in the introduction and growth stages whereas Thietart *et al.* (1984) found the use of price cutting will increase the market share of a firm in the maturity and decline stages.

These findings contradict results into the relationship of relative price with ROI and CFOI (Anderson *et al.*, 1984), of which both show a positive relationship between price and the respective performance measures. The contradicting findings represent a wider debate into pricing strategy which contends that successful companies are strict in their adherence to one of two pricing strategies to differentiate themselves from competition (Hall, 1980). Following the conflicting findings in the studies evaluated.

In relation to other factors within the supply side, the effect of time to market appears to generate conflicting results. First, González *et al.* (2002) found that an increase in speed to

market positively influenced new product success in support of various literature which contend that cycle time acceleration will increase market competitiveness (Golder *et al.*, 1997). Conversely, Anderson *et al.* (1984) found an increase in development time would have a negative effect of ROI in the maturity stage. An explanation for this relationship was omitted in the study and the result seems to contradict the traditional consensus in the area. Thus it may be pertinent to explore this relationship further given that there appears to be some undisclosed boundary conditions at play.

4.2.4. Demand

Results from our review show that a demand centric approach is becoming an increasingly popular method of addressing the issue of retrospective sales data. In the past decade, 75% of articles have used a demand centric approach through DOI theory. The DOI model was first proposed by Bass (1969) as a way to model growth of a new product or technology through the timing of adoption. Throughout the years, the original model has been developed to incorporate the effects of internal (word-of-mouth) communication, external communication, pricing strategies, advertising, and timing to market (Mahajan, 1990). However, these models are less able to predict the maturity and decline phases of the lifecycle. Recently, two studies have sought to remedy this. The first, Ewing et al. (2008), employed the consumer mechanisms of constitutive and symbolic utility to model brand death. The second, Yi et al. (2019), used diffusion and hazard models to model growth and decline. Both represent promising developments in the demand-side determinant literature.

Similarly, frequent recommendations for further research into the demand-side of the PLC have been proposed in the conceptual literature (see Appendix 1) which range from consumer psychological mechanisms to market demographics. Therefore, from a review of the literature, two dominant demand streams seem to have emerged; (1) the use of diffusion models

and (2) the use of consumer psychological experience mechanisms. Given that these fields, especially related to consumer psychological mechanisms, are relatively new to the area, a potential roadmap for this stream of research will be discussed in the next section.

5. Advancing the PLC Concept

The purpose of this study was to provide the foundation to advancing the PLC concept in light of marketing academia's recommendation for such an update. We also found there is a consensus among academics in the specific type of empirical PLC studies they wish to see in the future. Figure 7 shows most marketing academics believe all research avenues have merit, however, they believe longitudinal studies using the PLC and applying the PLC across contexts are the two most valuable future directions, whilst replication studies are the least valuable. The results of our review are in line with this consensus and will be elucidated henceforth.

---Figure 7 here---

Generally, we find that research on the PLC has declined in the last decade despite its continued popularity as a tool in business education and practice. Our review finds two key explanations for this trend; (1) despite its intuitive appeal in teaching, the PLC lacks the methodological foundations which allow it to be operationalized consistently in research, and (2) due to this lack of practical applicability, an updated research agenda has not been proposed or conducted, which leads to the perception of the PLC as an outdated framework. We believe that addressing the first issue will pave the course for addressing the second. Therefore, the conclusion will, first, provide some concrete methodological suggestions of how to model the PLC in line with current research developments. Then, once several modelling strategies are proposed, it will suggest several future research directions which are rooted in the modern-day

market. In providing an updated research agenda with both methodological and application recommendations we aim to pave the way to the advancement of the PLC concept.

5.2. Future Research Agenda: Methodologies

Based on our review, it seems the most fundamental issue of the PLC is its inability to predict product sales and therefore its limited managerial applicability. Clearly to allow the PLC to persist as a tool, not only in teaching, but in contemporary, managerially relevant research and practice, this issue needs to be addressed. Early PLC research has relied on the use of past sales data as a modeling base, however, this is viewed by many as a redundant, uninformative approach (Hunt, 1976). However, a parallel, increasingly popular approach is to investigate and model the PLC from the perspective of the customer. From the review of the previous literature, 3 potential avenues emerge which may use a customer-centric approach to progress the PLC from an abstract framework to an operationalizable tool; AI and big data, demand modelling, and consumer psychological mechanisms. Table 7 provides a summary of these approaches.

--- Table 7 here ---

5.2.1. Artificial Intelligence and Big Data

AI is primarily used to control and analyze numerical data. One of the key developments of AI, proposed by Davenport *et al.* (2020), is an increase in its predictive ability. In fact, the use of consumer analytics to forecast demand has already begun in certain studies (Chong *et al.*, 2017; Zhao *et al.*, 2012). For example, by using customer reviews and online promotional variables in neural network analysis, Chong *et al.* (2017) were able to forecast the level of online product demand. Similarly, Calder *et al.* (2016) propose big data can be utilized from a psychological perspective through sentiment analysis to predict brand engagement levels. This

area may be particularly useful for those investigating the brand lifecycle, given that engagement is shown to predict brand loyalty and purchase intentions (Hollebeek, 2011). The main implication of this development for PLC research is that long spanning, retrospective data sets are no longer necessary to predict sales, instead, we are now able to predict the demand of very new products (Zhao *et al.*, 2012) without the need for extensive sales data to input into the algorithms.

5.2.2. Diffusion Models

As explained, a pertinent issue with the legitimacy of the PLC as a marketing tool is its inability to forecast stages. However, one stream of literature which has addressed this issue is the diffusion literature (e.g., Bass, 1969; Lilien, 1980; Mahajan *et al.*, 1979; Norton *et al.*, 1987). The DOI literature models customer demand data to predict later PLC stages based on sales, price, penetration, and repeat and replacement purchase data. The success of this approach is reflected in the fact that in the past decade, 75% of articles have taken a diffusion perspective (e.g., Delre *et al.*, 2016; Yi *et al.*, 2019). Therefore, it seems it is now the most expedient approach to the PLC. Although this research has proved successful, most focus on the growth stage of the lifecycle. Therefore, an extension of this type of research which takes a demand-centric approach to the lifecycle (cf. Branstad *et al.*, 2020), especially in the maturity and decline stages of the PLC, may prove an effective course to revive the PLC concept.

5.2.4. Consumer Psychological Mechanisms

A very small number of studies have taken the consumer centric design a step further by using consumer psychological concepts to provide a bottom-up approach to the PLC (e.g., Ewing et al., 2009). In the same way as the diffusion literature, this type of literature seeks to predict the product demand, and therefore the resulting PLC. However, rather than a modelling approach,

this literature attempts to understand the psychological mechanisms that explain and predict the dynamics of a consumer's relationship with a product moving forward. This approach would appear to have theoretical merit, with many psychological relationship concepts proving effective in predicting various brand outcomes (Batra et al., 2012; Malär et al., 2011). In addition, it is less restricted than diffusion/demand modelling in terms of PLC stage, product type, product novelty, and supply restrictions (cf. Mahajan et al., 1990). However, to make substantial developments to the PLC literature generally, the approach must be applied more widely to different market contexts.

In order to provide more concrete suggestions on how a customer-centric perspective can be used to predict the PLC, we conducted a review of relevant literature on factors that cause changes in consumer–brand relationships. By doing this, we aim to consolidate rationale in the areas of consumer branding and lifecycle research to provide an indication of possible consumer centric predictors of the PLC. The results of which can be found in Table 8.

--- Table 8 here ---

In light of our review, we propose that the psychological mechanisms which affect lifecycle trajectory can be split into two sections: functional and symbolic. Functional appraisal contains rational factors which evaluate the product/brand based on the benefits/costs provided. Each of these mechanisms has been demonstrated to have an effect on a number of relational outcomes such as commitment, attachment, and relationship continuance, and could therefore act as a proxy to the PLC stages – particularly the maturity and decline stages.

From the review, we also find other frameworks of relationship or lifecycle change proposed in the literature in B2C and B2B contexts, which we suggest may also provide helpful recommendations for the future of the consumer centric PLC approach (Harmeling *et al.*, 2015; Zhang *et al.*, 2016). In summary, we provide suggestions of factors which are indicated to be

related to dynamic change in a lifecycle of a product or brand at customer level. To create a predictive framework of the PLC from a customer perspective in the future, we would suggest a longitudinal design to test the proposed mechanisms. Potential operationalizations for such a study may follow methods similar to Harmeling *et al.* (2015) and Zhang *et al.* (2016).

5.3 Future Research Agenda: Application

As previously stated, a key issue hampering the PLC is the dearth of up-to-date literature. The majority of the PLC research was conducted in the 90s, however, a shifting global market and consumer trends mean firms are competing in a vastly changed landscape from 30 years ago. Despite market developments, conceptual adaptations of the PLC have lagged behind, with the original PLC proposed in the 60s still being taught, as shown from our survey results and textbook analysis. In addition to the lack of up-to-date literature, we find in the evaluative framework that investigations into macroenvironmental factors have lagged behind other research streams. Therefore, we propose several ways in which the PLC tool could be applied to topical market trends, and why the use of this framework will not only improve the framework itself but also provide unique insights into the different phenomena.

5.2.1. Online PLCs

The first development in the market, especially since the Covid-19 pandemic, is the consistent trend towards online markets which has seen global e-commerce sales rise in its share of all retail sales by 3% (UNNews, 2020). Although e-commerce now has a 19% share of all retail sales globally, thus far no known studies have investigated the online PLC. Not only is it important to represent the context of today's market, but the shift to online is likely to have some interesting theoretical implications for the PLC also. For example, the ubiquity of online shopping means it is likely to be less affected by physical environmental factors and less reliant

on a local customer base, which would imply a longer, more stable PLC. However, the concentrated competition in the online marketplace is shown to cause less customer loyalty for certain brands (Danaher *et al.*, 2003). Therefore, the effect of online versus offline on the relative PLC is yet to be determined and seems to be an avenue worth investigating further.

The e-commerce trend is also giving rise to another market trend; subscription services. Previous research has shown the consumption patterns of subscription services is vastly different to traditional products (McCarthy *et al.*, 2017). Compared to non-subscription offerings, the subscription business models entail a greater customer investment at initial sale, but would likely generate greater stability with repeat purchases and more resistance to negative shifts and termination of the transaction. The ultimate aim of subscription services is to increase customer retention, but does this translate to more stable lifecycles? Does the contractual obligation associated with subscription services improve customer loyalty in the case of brand transgressions, or do customers resent the contractual relationship when things go wrong? And what effect does this have on a brand's lifecycle? The context of e-commerce lends itself to investigations using online reviews, social media data, and online behavior to further understand how the PLC behaves in the e-commerce context. Some studies, such as, Chevalier et al. (2006) have begun to use online reviews to forecast online sales behavior, and have found interesting results in relation to how customer reviews relate to sales over time.

RQ1a: How does the nature of online, hybrid, or high street brands affect their lifecycle?

RQ1b: How do the lifecycles of online products/services (e.g., subscription services) differ from the lifecycles of offline products/services?

5.3.2. Global Versus Local PLCs

The second major development in the market affecting the PLC is globalization (and more recently anti-globalization) (Witt, 2019). At this point of potential divergence in the global landscape, what effect does culture and country have on the PLC? Extant research has found cultural differences with regards to brand loyalty (Palumbo *et al.*, 2000), brand equity (Yoo *et al.*, 2002), and purchase behavior (Kim *et al.*, 2002). Consequently, the implications of culture on the PLC may be significant, especially given the different macro and microenvironments that products exist in globally.

As a result of the difference in global and local marketplaces, it may also be fruitful to assess the implications of global vs local firms on the PLC. Research has shown global brands are generally more technologically innovative and adaptive whereas local brands are more embedded in local markets and communities, have stronger ties to the past and cover niche for longer periods (Sichtmann *et al.*, 2019). As such, it seems likely that local brands have comparatively longer brand cycles than global brands. Therefore, investigating whether customer dispositions toward globalization or ethnocentric tendencies (Balabanis *et* al, 2004) shorten or extend the lifecycles of global and local products would be worthwhile.

Although the way in which country of origin strategies interact with PLC stages has been addressed in previous research (Niss, 1996), another interesting area in relation to the PLC may be the use of standardization vs adaptation strategies. Results from Anderson *et al.* (1984) showed an effect of PLC stage on the success of an adaptation strategy. But given the prevalence of this strategy in global markets, understanding its implications would represent a meaningful development in PLC research. Would these results translate to the global marketplace? Given that Anderson *et al.* (1984) found generally negative results, one would assume that there are significant differences in the interaction of standardization/adaptation strategies and PLC stages in home and foreign markets, but these are yet to be explored. This could be done by using each of the three methodological approaches proposed in the previous

section, depending on the perspective taken in the study. Previous research shows how AI/big data (Kushwaha *et al*., 2021), demand data (Allred & Park, 2007), and consumer psychological mechanisms (Sichtmann *et al*., 2019) have all been used in international marketing research so there is scope for the use of each strategy related to the PLC.

RQ2a: How do the PLCs of products from global and local firms differ?

RQ2b: How does globalization (or anti-globalization) affect the PLC?

RQ2c: How does a standardization vs adaptation strategy affect the PLC of international brands?

5.3.3. Sustainability and PLCs

The third major development in the market is the increased focus on sustainability from both a consumer and firm perspective. PLC management literature, which focuses on the manufacturing and engineering perspective of the lifecycle, has provided a myriad of research in this area (cf. Cao *et al.*, 2012; Shuaib *et al.*, 2014). Unsurprisingly, given the impetus on slower consumption cycles, firms are advised to focus on providing withstanding, longer lifecycle products to appeal to the demand for sustainability (Cooper, 2005). What is yet to be looked at, is the impact of sustainability on the marketing PLC. However, given the insurgence of research in this area, it may provide some interesting research ideas. For example, corporate social responsibility (CSR) initiatives have shown to increase customer satisfaction (Luo *et al.*, 2006) and identification (Bhattacharya *et al.*, 2004), which in turn are shown to influence customer purchase intention (Keh *et al.*, 2009). Thus, leveraging the sustainability factor may lengthen the PLC, but this is contingent on the product's adherence to sustainability initiatives such as the banning single use plastics and reducing $C0_2$. For products that do not adhere to these new initiatives, sustainability may in fact be shortening the PLC. Therefore, future research may wish to understand the effectiveness of promoting sustainability dependent on

the stage of the PLC and the type of product in their offering. To understand the effect of sustainability strategies on customer demand at different stages of the PLC, future researchers may wish to utilize sales and penetration data within their models to forecast future sales trends, as in Guo (2014).

RQ3a: How does the role of sustainability impact the PLC?

RQ3b: Should firms aim to elongate their PLC in line with slower consumption cycles?

RQ3c: Does promotion of elongated product life increase product demand?

RQ3d: At what stage of the PLC are sustainability strategies most successful?

5.3.4. Sharing Economy PLCs

One way in which brands are promoting sustainability is through the utilization of the sharing economy as 76% of consumers believe this strategy is beneficial to the environment (PwC, 2015). The implications of this new business model on the PLC may represent another interesting avenue for future research. Specifically, the factors which affect the sharing economy and its PLC appear to be distinct from those of traditional PLCs. For instance, a key determinant of the PLC traditionally is product/service quality (e.g., Tellis *et al.*, 1988). However, given the relegated importance of quality in the sharing economy and the firms' lack of control over it (Eckhardt *et al.*, 2019), the impact of this once key factor is questioned. Furthermore, Eckhardt *et al.* (2019) argue that the effect of service quality may also be attenuated in the sharing economy as consumers view failure by other co-consumers less harshly than from a service provider. Together, this points towards a more stable, lengthier PLC for the sharing economy. The relatively stable consumer centric benefits of sustainability and financial benefits provide further evidence for this (Hamari *et al.*, 2016). However, the increased effect of regulatory factors (Hong *et al.*, 2018) especially given recent issues with some sharing economy providers (Ghosh, 2019), casts doubt over the seemingly stable picture

of the sharing economy PLC. Therefore, the effect of institutional and regulatory factors may present another future research area.

Finally, a key question in consideration of the application of the PLC concept to the sharing economy is what level of product aggregation should this investigation be framed? Are consumers in a sharing economy forming a relationship with the service provider, the brand, or their co-consumers? What are the implications for each lifecycle? Similar questions have been proposed in a review of the sharing economy (Eckhardt *et al.*, 2019), however applying the lifecycle concept to this area may provide the structure needed to organize research on this novel business model. The key premise of the sharing economy is its implication on the stability of the PLC, therefore methodologies using forecasting tools which incorporate demand, similar to the bass diffusion model, may prove most effective (e.g., Guo, 2014) in understanding this issue.

RQ4a: Are PLCs more stable in the sharing economy?

RQ4b: What is the effect of regulatory and institutional factors on the sharing economy PLC?

RQ4c: At what level do consumers form a relationship with service providers in the sharing economy (the brand, the co-consumer, the firm)?

5.3.5. Pandemic PLCs

A recent development in the global market which is argued to be one of the most significant environmental changes in modern marketing (He *et al.*, 2020) is the Covid-19 pandemic. The uncertainty of the Covid-19 pandemic has forced brands to adjust their long-term marketing strategies and listen to the customer in real time to adapt their campaigns (Diebner *et al.*, 2020). The agility and emotional connection cultivated in the pandemic pivot has worked well for certain brands and industries (Guillén, 2020). As things steadily return to pre-pandemic

conditions, should brands continue to use this improvisation approach or return to their long-term brand goals? Using the PLC framework could provide a structured method to analyze the merits of each approach to see if increased agility increases both short- *and* long-term outcomes and/or if this will change as customer attitudes settle after this turbulent period. Such an analysis may wish to utilize longitudinal approaches, specifically event study approaches (Sorescu *et al.,* 2017), to understand and compare the differences in the lifecycles before and after the pandemic, both in the short- and in the long-term. Studies such as Borah and Tellis (2014) and Tipton et al. (2009) provide examples of such a methodology which may be utilized in relation to the PLC in the future.

RQ5a: How has the pandemic affected PLCs?

RQ5b: What are the implications of diverging brand responses to the pandemic crisis (e.g. forced flexibility, short term reactivity, etc.) and how will they affect their PLC's development in the short-, medium- or long-term?

5.4. Future Teaching Agenda

Beyond marketing research, the PLC is commonly used in marketing education and practice. To understand the state of teaching with the PLC, we reviewed current higher education textbooks in the main domains of marketing which are relevant to the PLC; introductory, services, B2B, consumer behavior, international marketing, digital marketing, and marketing communications textbooks (see note 1). To assess the relative usage of the PLC in each domain, the percentage of pages dedicated to the PLC was analyzed and the average was calculated for each domain. The results were as follows; introductory (2.1%), consumer behavior (1.5%), international marketing (0.9%), digital marketing (0.6%), marketing communications (0.5%), services (0.5%), and B2B (0.5%).

The results are largely as expected, as an introductory framework, the PLC has featured most in introductory textbooks. However, despite consumer behavior textbooks demonstrating the second highest percentage of pages dedicated to the PLC, the content is largely devoted to the DOI literature and, in fact, highlighting the differences between the DOI and PLC. In light of our findings and recommendations in this review, future teaching may wish to refrain from such compartmentalization and discuss the implications consumer psychological mechanisms may have on the strategic decisions of a product's life, as in some extant research (e.g., Ewing *et al*., 2008; Yi *et al.,* 2019). The analyzed international marketing textbooks provided arguably the most integrated use of the PLC in their domain by proposing an adapted international product lifecycle (IPLC) which was lagged based on the market. They also discussed the implications of the PLC to trade, exporting, and technology. The international marketing area may, therefore, pave the way for how the PLC can be integrated seamlessly into a key marketing domain, although they may still wish to consider the impact of global vs local lifecycles, and country of origin on the PLC, and integrate this into the relevant frameworks. Digital marketing, marketing communications, services, and B2B textbooks all utilized the PLC similarly, dedicating approximately one page to a brief discussion of the framework and the implications to their area. However, from the discussion presented above in terms of the sharing economy and digitization, it is clear the PLC has more far reaching and integral implications than are currently discussed in teaching practice, especially in relation to topical shifts in the market. In order for the PLC to be viewed as a contemporary framework able to shape managerial decisions in the modern world it must be considered and taught as such when it is first introduced.

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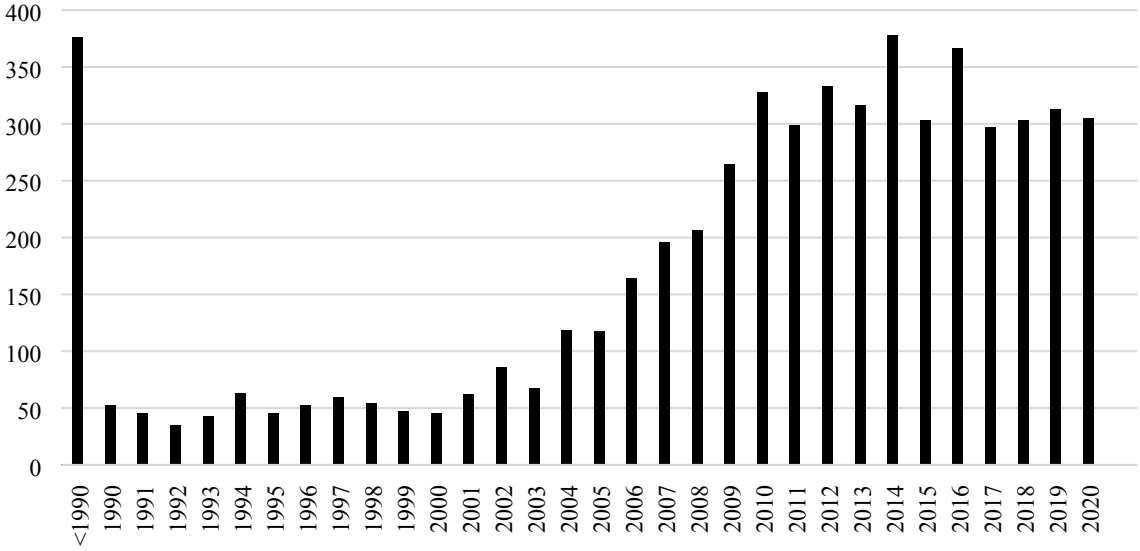
Note: * = reference included in the evaluative framework analysis, [a] = reference included in citation analysis

Figure 1: Number of Citations of 79 Product Life Cycle Papers from 1990-2020



Note: Following precedence in the literature (Ismagilova *et al.,* 2020) citation records were collected on Scopus and Web of Science databases (All 97 articles reviewed in the main literature review were searched for but 18 were unavailable on either database resulting in 79 articles being analyzed. The specific articles analyzed are highlighted in the reference list by an [a] symbol)

Figure 2: Marketing Academics' Attitudes towards PLC Research

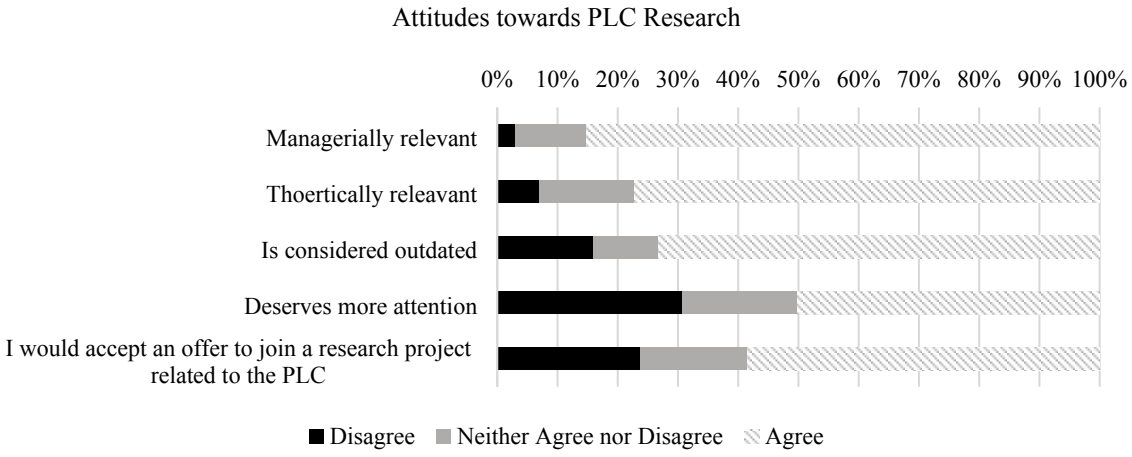


Figure 3: Marketing Academics' Attitudes towards PLC Teaching

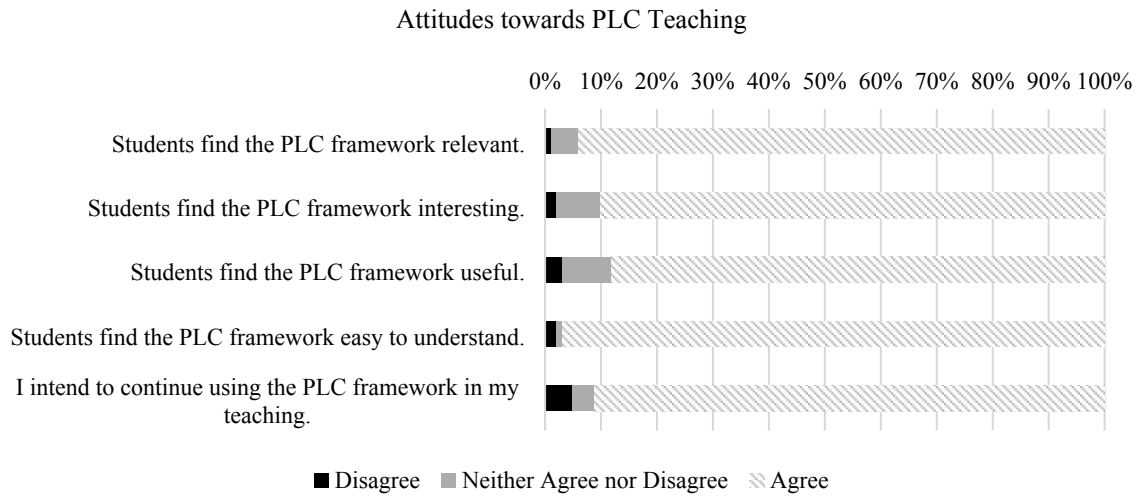


Figure 4: Marketing Academics' Perceived Advantages of the PLC

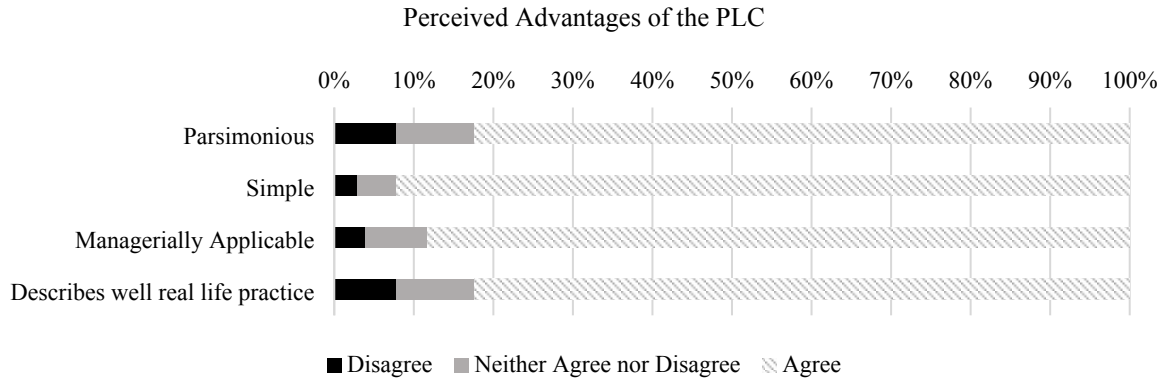


Figure 5: Marketing Academics' Perceived Disadvantages of the PLC

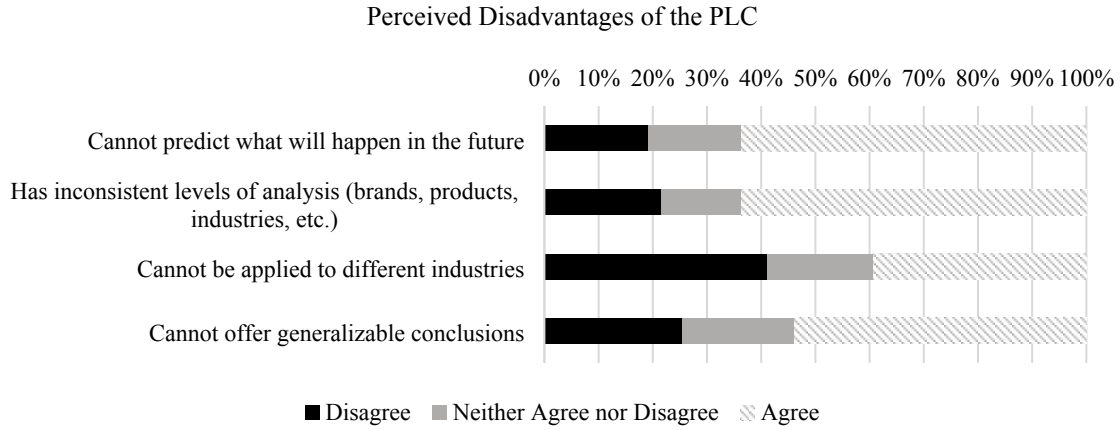


Figure 6: Conceptual Determinants Model (adapted from Lambkin and Day, 1989)

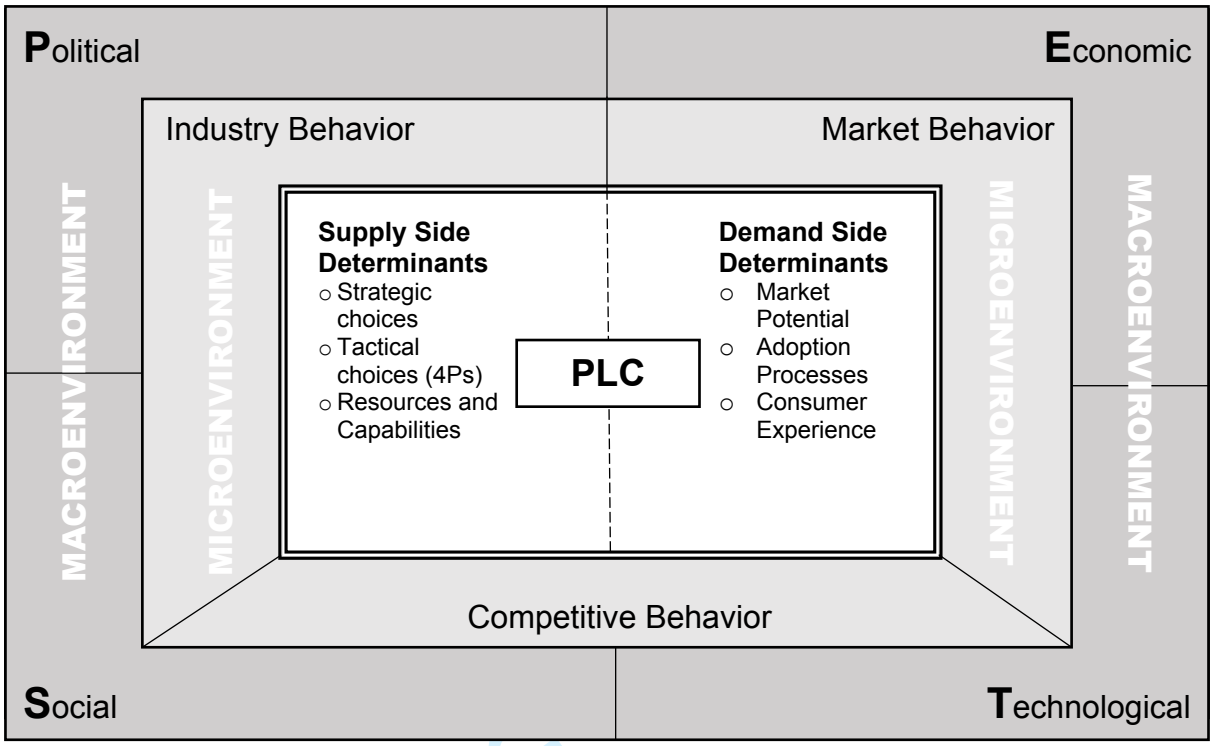


Figure 7: Marketing Academics Attitudes towards Potential Future Directions of the PLC

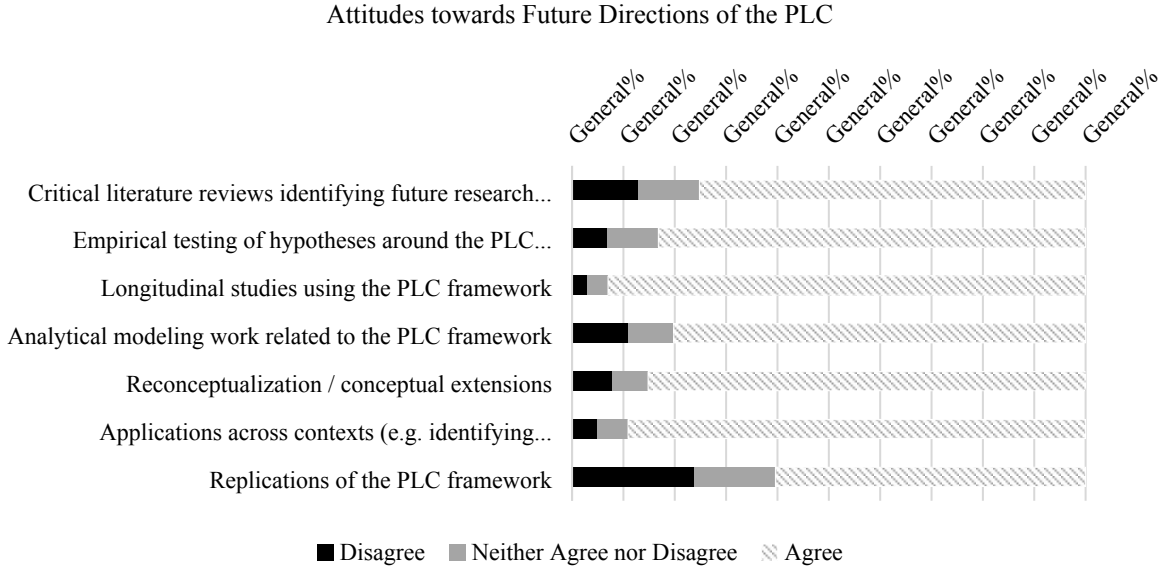


Table 1: Journals Analyzed in the Study

		Period						%
Journal	**Total**	**1960-70**	**1970-80**	**1980-90**	**1990-00**	**2000-10**	**2010-18**	
Journal of Marketing	17	2	2	8	2	2	1	17.5
Journal of Marketing Research	8	1	2	1	2	1	1	8.2
European Journal of Marketing	7	1		4	1	1		7.2
Harvard Business Review	5		3	2				5.2
Industrial Marketing Management	5				1	4		5.2
Journal of Business Research	5						5	5.2
Management Science	5	1		3	1			5.2
International Journal of Production Economics	4				1	2	1	4.1
Academy of Management Journal	3			3				3.1
Journal of Academy of Marketing Science	3		1	1		1		3.1
Journal of Business	3	2		1				3.1
Marketing Letters	3				1		2	3.1
Marketing Science	3				1	2		3.1
Technological Forecasting and Social Change	3			2		1		3.1
Journal of Product and Brand Management	2				1		1	2.1
Journal of Strategic Marketing	2				1	1		2.1
British Journal of Management	1				1			1
British Journal of Management	1				1			1
California Management Review	1		1					1
Econometrica	1	1						1
European Journal of Operational Research	1					1		1
European Journal of Operational Research	1					1		1
International Business Review	1					1		1
International Journal of Research in Marketing	1						1	1
Journal of Business and Industrial Marketing	1				1			1
Journal of Consumer Research	1			1				1
Journal of Global Marketing	1					1		1
Journal of Industrial Economics	1					1		1
Journal of International Business Studies	1			1				1
Journal of International Economics	1			1				1
Journal of World Business	1					1		1
Operations Research	1					1		1
Operations Research	1					1		1
Small Business Economics	1					1		1
Southern Economic Journal	1				1			1
Total	**97**							

Table 2: Definitions of the Criteria for the Evaluative Framework

Variables	Definition
Centrality of Concept	
Central	The product life cycle concept was investigated explicitly within the study
Peripheral	The product life cycle concept was implied within the study
Time Horizon	
Historical	Data collected in the past relative to the independent variable
Current	Data representing the same time period as the independent variable
Future	Data produced over a specified future period relative to the independent variable
Theme	
Validation	The purpose of the study is to empirically validate the existence of this phenomena and usefulness as a marketing tool
Issues	Highlighting and testing the issues with the PLC framework
Modification	Modifying the framework to fit with other areas of business/ academia
Usage	Using the framework in different contexts
Industry	
Durable	Products which are not consumed after three years of purchase (e.g. car)
Non-Durable	Products which are consumed within a maximum of three years of purchase. (e.g. toothpaste)
Services	Firms which primarily provide intangible products and services
N/A	The information was unavailable to the researcher/ inapplicable in this study
Customer Type	
Consumer	Products purchased by the end consumer
Industrial	Products purchased by firms to aid in the production of other goods
N/A	The information was unavailable to the researcher/ inapplicable in this study
Research Design	
Cross Sectional	The observation of variables at one point in time
Longitudinal	The repeated observation of the same variables at different points in time
N/A	The information was unavailable to the researcher/ inapplicable in this study
Measurement Referent	
Financial Indicators	The measurement of the product life cycle and its stages consisted of a financial indication e.g. sales, revenue, market share
Non-Financial	The measurement of the product life cycle and its stages consisted of a non-financial indication e.g. managerial reports, consumer demand
Modelling	A model was used to reflect certain aspects of PLC development
N/A	The information was unavailable to the researcher/ inapplicable in this study
Product Aggregation	
Form	The specific product (diet colas)
Class	The generic product category or subcategory (soft drink)
Brand	The brand name (diet Dr Pepper)
Firm	Entire firm product offering
Stage	
Introduction	Primary demand for product just starting to grow, products or services still unfamiliar to many potential users
Growth	Demand growing at 10% or more annually in real terms; technology and competitive structure still changing
Maturity	Products or services familiar to vast majority of prospective users; technology and competitive structure relatively stable
Decline	Products viewed as commodities; weaker competitors beginning to exit

Table 3: Evaluative Framework

		Period					
Classifier Variable	**Total n=97 (%)**	**1960-70 n_1=8**	**1970-80 n_2=10**	**1980-90 n_3=29**	**1990-00 n_4=14**	**2000-10 n_5=24**	**2010-2020 n_6=12**
Centrality of Concept							
Central	69 (71)	6 (75)	6 (60)	20 (69)	13 (93)	16 (79)	8 (67)
Peripheral	28 (29)	2 (25)	4 (40)	9 (31)	1 (7)	8 (33)	4 (33)
Time Horizon							
Historical	69 (71)	7 (88)	9 (10)	25 (86)	10 (71)	12 (50)	6 (50)
Current	18 (19)	1 (13)	0 (0)	1 (3)	3 (21)	8 (33)	5 (42)
Future	11 (11)	1 (13)	1 (10)	3 (10)	1 (7)	4 (17)	1 (8)
Theme							
Validation	5 (5)	2 (25)	1 (10)	1 (3)	1 (7)	0 (0)	0 (0)
Issues	4 (4)	1 (13)	0 (0)	2 (7)	1 (7)	0 (0)	0 (0)
Modification	10 (11)	2 (25)	0 (0)	2 (7)	4 (29)	2 (8)	0 (0)
Usage	80 (82)	4 (50)	9 (10)	23 (79)	10 (71)	22 (91)	12 (100)
Industry							
Durable	64 (66)	4 (50)	4 (40)	20 (70)	10 (71)	16 (67)	10 (83)
Non-Durable	22 (23)	3 (40)	2 (20)	8 (28)	4 (29)	5 (21)	0 (0)
Services	5 (5)	0 (0)	0 (0)	1 (3)	1 (7)	1 (4)	2 (17)
N/A	17 (18)	2 (25)	3 (30)	6 (21)	3(21)	4 (17)	2 (17)
Customer Type							
Consumer	73 (75)	7 (88)	3 (30)	21 (72)	12 (86)	19 (79)	11 (92)
Industrial	28 (29)	1 (13)	4 (40)	11 (38)	3 (21)	8 (33)	1 (8)
N/A	10 (10)	1 (13)	1 (10)	4 (14)	1 (7)	2 (8)	1 (8)
Research Design							
Cross Sectional	22 (23)	2 (25)	2 (20)	6 (21)	3 (21)	8 (33)	3 (25)
Longitudinal	64 (66)	6 (75)	7 (70)	20 (69)	10 (71)	13 (54)	8 (67)
N/A	9 (9)	1 (13)	1 (10)	2 (7)	1 (7)	3 (13)	1 (8)
Measurement Referent							
Financial	55 (58)	6 (75)	8 (80)	19 (66)	9 (64)	11 (46)	2 (17)
Non-Financial	15 (15)	1 (13)	0 (0)	2 (7)	2 (14)	6 (25)	4 (33)
Modelling	31 (32)	5 (63)	2 (20)	10 (34)	5 (36)	7 (29)	9 (75)
N/A	8 (8)	1 (13)	0 (0)	1 (3)	1 (7)	1 (4)	4 (33)
Product Aggregation							
Form	9 (9)	2 (25)	0 (0)	1 (3)	2 (14)	3 (13)	1 (8)
Class	57 (59)	4 (50)	3 (30)	19 (66)	7 (50)	15 (63)	9 (75)
Brand	14 (14)	2 (25)	4 (40)	3 (10)	3 (21)	2 (8)	0 (0)
Industry	12 (12)	1 (13)	1 (10)	5 (17)	3 (21)	2 (8)	0 (0)
N/A	8 (8)	0 (0)	2 (20)	2 (7)	0 (0)	2 (8)	2 (17)
Stage							
Introduction	80 (82)	7 (88)	8 (80)	24 (83)	13 (93)	19 (79)	9 (75)
Growth	77 (79)	7 (88)	8 (80)	24 (83)	13 (93)	16 (67)	9 (75)
Maturity	64 (66)	4 (40)	7 (70)	21 (72)	12 (86)	12 (50)	8 (67)
Decline	61 (63)	5 (63)	7 (70)	19 (66)	11 (79)	12 (50)	8 (67)

Note: % denotes the percentage of papers published in that decade

Table 4: Industries studied in previous research

Author	Industry
Consumer	
Cox (1967)	Ethical Drugs
Brockhoff (1967)	Automobile
Polli and Cook (1969)	Food/ Health/ Personal Care
Bass (1969), Bass (1980), Golder and Tellis (1997)	Consumer Durable Innovations
Claycamp and Liddy (1969)	Food/ Personal Care/ Household Supplies
Lilien (1980)	Solar Energy
Olshavsky (1980), Harrell, Taylor and Elmer (1981), Qualls, Olshavsky and Michaels (1981), Schultz and Rao (1986)	Household Appliances
Norton and Bass (1987)	High Technology
Easingwood (1987)	Consumer/ Industrial/Medical/ Educational
Holak and Tang (1990), Juttner, Godsell and Christopher (2006), Karakaya and Kerin (2007)	Tobacco
Mercer (1993)	Fast Moving Consumer Goods
Shankar, Carpenter and Krishnamurthi (1999), Bauer and Fischer (2000), Narayanan, Manchanda, Chintagunta (2005), Karakaya and Kerin (2007)	Pharmaceuticals
Stremersch et al. (2007), Stremersch, Muller and Peres (2010), Lemmens, Croux and Stremersch (2012)	Electronics
Industrial	
Cunningham (1969)	Heating Equipment
De Kluyver (1977)	Heavy Duty Trucks and Equipment
Tigert and Farivar (1981)	Optical Scanning Equipment
Popper and Buskirk (1992)	Technology
Nelson (1992)	Engineered Metals
Gonzalez and Palacios (2002)	Electronic Equipment/ Transport Equipment
Karakaya and Kerin (2007)	Biotech/ Waste Management

Table 5: Two comparative stage classifications (Cao and Folan, 2012)

Phases	Cox (1967)	Polli and Cook (1969)
Introduction	Up to 5000 new prescriptions in a single month	S_i less than 5% of peak sales
Growth	From 5000 new prescriptions in a single month	S_i greater than +0.05
Maturity	From maximum monthly revenue	S_i in the +0.05 to -0.05 range
Decline	Below 20% or 10% of maximum monthly revenue	S_i greater than -0.05

Note: S_i yearly sales of non-durable $_i$ divided by sales of all non-durables; S yearly percentage changes in S_i.

Table 6: Determinants Framework

Determinant	Introduction	Growth	Maturity	Decline
MACRO				
Government Mediation	0	0	0	0
Active Management of Influential Bodies	+	+	+	+
MICRO				
Market Penetration	+	N/A	N/A	N/A
Time to Market	+	+	N/A	N/A
Development Time (ROI)	N/A	0	-	0
Capacity/ Market Size (ROI)	0	0	+	+
Capacity/ Market Size (CFOI)	0	0	+	+
Introduction of Substitutes	N/A	N/A	-	-
Market Growth	0	0	N/A	N/A
Supply: Product				
Product Quality	+	+	+	+
Product Quality	+	+	+	+
Relative Product Quality (ROI)	N/A	+	+	0
Relative Product Quality (MS)	N/A	+	+	0
Relative Quality (ROI)	0	0	+	+
Product Quality	+	+	N/A	N/A
Relative Quality of Services (ROI)	N/A	0	0	0
Relative Quality of Services (MS)	N/A	+	0	+
Product R&D (ROI)	N/A	-	-	0
Product R&D (MS)	N/A	+	0	0
R&D Effort	0	0	0	+
R&D Effort	N/A	N/A	+	+
Product Customization (ROI)	N/A	-	-	0
Product Customization (MS)	N/A	0	0	-
Relative Product Breadth (ROI)	N/A	0	0	0
Relative Product Breadth (MS)	N/A	+	+	0
Relative Product Breadth (ROI)	0	0	0	-
Product Innovation	+	+	+	+
Product Innovation	N/A	N/A	+	+
Top Management Support for Innovation	+	+	N/A	N/A
Technology Vintage (the passage of time)	+	+	N/A	N/A
Rapid Prototyping	-	-	N/A	N/A
Design Techniques	0	0	N/A	N/A
Supply: Promotion				
Aggressive Promotional Effort	+	+	+	+
Increased Sales Effort	N/A	+	+	0
Sales Force/ Revenue (ROI)	N/A	-	0	0
Sales Force/ Revenue (MS)	N/A	0	0	+
Relative Advertising Expenses (ROI)	N/A	0	0	0
Relative Advertising Expenses (MS)	N/A	0	-	-

Marketing Communications (direct effect)	0	+	+	+
Marketing Communications (indirect effect)	+	0	0	0
Emotional Advertising (brand building)	0	0	+	+
Increased Marketing Effort	0	0	0	+
TV Advertisements	N/A	+	N/A	N/A
Search Engine Optimization	N/A	+	N/A	N/A
Supply: Price				
Price Cutting	+	+	N/A	N/A
Price Cutting	0	0	+	+
Relative Price (ROI)	0	0	0	0
Relative Price (ROI)	0	+	+	-
Relative Price (CFOI)	0	+	+	0
Supply: Distribution				
Operating Efficiencies	+	+	+	+
Supply: Other				
Country of Origin	+	+	0	0
Firm Knowledge	+	+	0	0
Use of Information Technologies	+	+	N/A	N/A
Manufacturing Techniques	+	+	N/A	N/A
Multi-Functional Integration	0	0	N/A	N/A
Capacity Utilization (ROI)	N/A	0	+	+
Capacity Utilization (MS)	N/A	0	0	0
Employee Productivity (ROI)	N/A	+	+	+
Employee Productivity (MS)	N/A	0	0	0
Value Added/ Revenue (ROI)	N/A	+	+	+
Value Added/ Revenue (ROI)	N/A	0	0	0
Relative Integration Backward (ROI)	N/A	0	0	0
Vertical Integration Backward (ROI)	+	0	0	0
Relative Integration Backward (MS)	N/A	+	+	0
Relative Integration Forward	N/A	0	0	0
Vertical Integration Forward (ROI)	0	+	0	0
Vertical Integration Forward (MS)	0	0	+	0
Plant and Equipment Newness (ROI)	0	0	0	0
Plant and Equipment Newness (CFOI)	-	0	0	-
Capacity Utilization (ROI)	0	0	+	+
Capacity Utilization (CFOI)	0	0	+	0
Market Share Investment	+	+	+	-
Market Share (ROI)	N/A	+	+	0
Demand				
Number of Previous Buyers	+	N/A	N/A	N/A
Rate of Adoption	+	N/A	N/A	N/A
Relative Customer Breadth (CFOI)	0	0	-	+
Customer Involvement	0	0	N/A	N/A
Customer Satisfaction	N/A	N/A	+	+

Relative Number of Customers (ROI)	-	0	+	-
Relative Number of Customer (CFOI)	-	0	+	-

Note: + : independent variable increases dependent variable at particular stage, - : independent variable decreases dependent variable at particular stage, 0: independent variable has no effect of dependent variable, N/A: relationship was not tested

Table 7: Potential Methodological Approaches to PLC Research

Strategies for Modelling the PLC	Methods for Collecting Data	Modelling Approaches and References	Example Publication Outlets Where Methods have been Applied
AI / Big Data	Online Reviews, Promotional Variables, Sentiment Analysis (Social Media, Reviews), Product Sales, Online Behavior	Neural Network Analysis (Chong *et al.*, 2017), Sales Logs (Chevalier *et al.,* 2006)	International Journal of Production Research, Journal of Marketing Research
Demand Data	Sales, Price, Penetration, Repeat and Replacement Purchase Data	Numerical Stability Analysis (Orbach *et al.*, 2014), Bass Diffusion Model (Guo, 2014)	Marketing Letters, International Journal of Production Economics
Consumer Psychological Mechanisms	Primary longitudinal consumer surveys (Possible constructs: satisfaction, evaluation of alternatives, investment, disruptive events, trust, self-concept, brand congruence, reference group appraisal)	Hidden Markov Modelling (Zhang *et al.*, 2016), Latent Growth Curve Modelling (Palmatier *et al.*, 2013)	Journal of Marketing, Journal of Business Research

Table 8: Summary of Consumer Centric Predictors of Relationship Change in Previous Studies

Functional Appraisal	References	Symbolic Appraisal	References
Satisfaction	Aaker *et al.* (2004); Drigotas *et al.* (1992); Kim *et al.* (2009); Oliver (1993); Sung *et al.* (2010)	**Self-Concept**	Reimann *et al.* (2012)
Evaluation of Alternatives	Shukla *et al.* (2015); Sung *et al.* (2010)	**Brand Personality/ Brand Congruence**	Malär *et al.* (2011)
Investment	Drigotas *et al.* (1992); Sung *et al.* (2010)	**Reference Group Appraisal**	Ewing *et al.* (2009)
Disruptive Events	Aaker *et al.* (2004); Wan *et al.* (2011)		
Trust	Albert *et al.* (2013); Grayson *et al.* (1999); Lewicki *et al.* (2006)		

Appendix 1: Theoretical Determinants

INTRODUCTION	**Micro**	**Supply: Price**	**DECLINE**
Macro	Type of Industry	Retail Price	**Macro**
*Interest Rates**	*Barriers to Entry**	**Supply: Promotion**	*Major Changes in Availability of Raw Products**
Micro	*Degree of Specialization within the Industry**	*Anti-Trust Regulations**	*Interest Rates**
Type of Industry	*Number of Equal Products**	**Micro**	**Micro**
Supply: Product	**Supply: Product**	Type of Industry	Market Size
Newness of Product	Type of Product	*Barriers to Entry**	*Degree of Specialization within the Industry**
Rate of Technological Change in Product Design	Product Quality	*Number of Equal Products**	**Supply: Product**
Product Quality	Rate of Technological Change in Product Design	*Degree of Specialization within the Industry**	Product Quality
*Uniqueness of Product**	*Patent Exclusiveness**	**Supply: Product**	**Supply: Price**
*Packaging and Design**	Supply: Promotion	Type of Product	Price/ Cost Structure
*Product Complexity**	Marketing Intensity	Rate of Technological Change in Product Design	Supply: Distribution
Supply: Price	**Supply: Other**	*Degree of Product Differentiation**	*Marginal Plant Size**
Skimming	*Money Supply**	Product Quality	*Transportation and Distribution Costs**
Supply: Distribution	Market Share	Supply: Price	**Supply: Other**
*Distribution Decisions**	**Demand**	Pricing Differentiation	Degree of Capacity Utilization
Supply: Other	*Buyer Needs**	Supply: Promotion	*Relative Wage Rate**
*Money Supply**	*Buyer Concentration**	Marketing Intensity	**Demand**
Demand	*Purchase Frequency**	*Niche Marketing**	Buyer Loyalty
*Buyer Needs**	*Hierarchy of Needs**	Supply: Distribution	Elasticity of Demand
*Purchase Frequency**		*Transportation and Distribution Costs**	Age Distribution of Population
*Hierarchy of Needs**	**MATURITY**	Supply: Other	Degree of Customer Concentration
*Fit to Customer Needs**	**Macro**	Degree of Capacity Utilization	
*Number of Individuals Involved in Single Purchase**	*GNP Trends**	Discretionary Cash Flow	
*Favorable First Experience**	Governmental Mediation	Market Share	
	Influential Bodies	**Demand**	
GROWTH	**Micro**	*Market Segmentation**	
Macro	*Competition**	*Buyer Needs**	
*GNP Trends**	*Barriers to Entry*	*Purchase Frequency**	

Note: normal formatting: empirical study has investigated this determinant, *italics**: no empirical study has investigated this determinant