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A Debate on the Product Lifecycle Implications and Product Market Behavior

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Abstract – The product life-cycle marketing approach is a concept that describes the sales and profit margin of a given product category over a prolonged period - from lust to dust. The concept holds that a product's sales and profits change over time in a predictable manner-at least in the four distinct major stages of introduction, growth, maturity, and decline. It is important to understand product life-cycles curves to make the best use of engineering resources. The paper presents figures that characterize various industry products and their life-cycle curves. The amount of development money invested in a product intended for rapid market penetration, for example, is considerably less than for a one destined to a long-term stable, mature market. In this context we illustrate the types of feedback used by engineering during the various stages of product life-cycle. Finally, we consider that engineers responsible for product or process improvement must recognize what phase of the product life-cycle is in to practice the most effective research.

Keywords: Product Life-Cycle, Marketing, Models of Product Life-Cycle Editing.

I. INTRODUCTION

Today's consumers are increasingly selective in product choice and consequentially target markets are fragmenting. Simultaneously, product life cycles are shortening, competition is intensifying, and the new product failure rate is growing. Understanding the consumer buying process can make the difference between success and failure in consumer marketing strategies [2]. In this context, the diverse topics associated with product lifecycle requires a multidisciplinary approach [13] and this will be reflected in the present article scientific discourse.

The historical context, design, engineering, marketing, law, politics, consumer behavior, technology and systems of provision are all covered, although critics will note that other fields, notably human geography, anthropology and economics, are perhaps inadequately represented but they can be deducted as back-side knowledge and approaches.

It is a fundamental idea of marketing that organizations survive and prosper through meeting the needs and wants of customers. This important perspective is commonly known as the marketing concept. The marketing concept is about matching a company's capabilities with customer wants. This matching process takes place in what is called the marketing environment [8, 10].

Businesses do not undertake marketing activities alone [9]. They face threats from competitors, and changes in the political, economic, social and technological environment. All these factors have to be taken into account as a business tries to match its capabilities with the needs and wants of its target customers. An organization that adopts the marketing concept accepts the needs of potential customers as the basis for its operations. Success is dependent on satisfying customer needs [8, 9].

How can customers' needs be characterized? A need is a basic requirement that an individual wishes to satisfy. People have basic needs for food, shelter, affection, esteem and self-development. Many of these needs are created from human biology and the nature of social relationships. Customer needs are, therefore, very broad. Whilst customer needs are broad, customer wants are usually quite narrow. A want is a desire for a specific product or service to satisfy the underlying need [3, 10, 13].

Social and cultural forces, the media and marketing activities of businesses, shape consumer wants and desires. This leads on to another important concept - which of customer demands. Consumer demand is a want for a specific product supported by an ability and willingness to pay for it. For example, many consumers around the globe want a Mercedes. But relatively few are able and willing to buy one [9, 14, 15].

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Businesses therefore have not only to make products that consumers want, but they also have to make them affordable to a sufficient number to create profitable demand. Businesses do not create customer needs or the social status in which customer needs are influenced (e.g., it is not McDonalds that makes people hungry). However, businesses do try to influence demand by designing products and services that are: attractive, works well, are affordable and available. Businesses also try to communicate the relevant features of their products through advertising and other marketing promotion, which leads us finally to an important summary point [1, 10].

1.1. A Marketing Orientated Business

Whilst marketing references [8, 15] usually suggest that successful business will be "marketing orientated", it is the case in the real world not all businesses subscribe to the marketing concept. The implications of believing in the marketing concept become clearer when the alternatives are examined. There are three main alternatives to adopting a marketing orientation. These are [1, 8, 9, 10]:

- **Sales orientation** - Some businesses see their main problem as selling more of the product or services, which they already have, available. They may therefore be expected to make full use of selling, pricing, promotion and distribution skills (just like a marketing-orientated business). The difference is that a sale-orientated business pays little attention to customer needs and wants, and does not try particularly hard to create suitable products or services;
- **Production orientation** - A production-orientated business is said to be mainly concerned with making as many units as possible. By concentrating on producing maximum volumes, such a business aims to maximize profitability by exploiting economies of scale. In a production orientated business, the needs of customers are secondary compared with the need to increase output. Such an approach is probably most effective when a business operates in very high growth markets or where the potential for economies of scale is significant;
- **Product orientation** - This is subtly different from a production orientation. Consider a business that is "obsessed" with its own products – perhaps even arrogant about how good they are. Their products may start out as fully up-to-date and technical leaders. However, by failing to consider changing technological developments or subtle changes in consumer tastes, a product-orientated business may find that its products start to lose ground to competitors.

The process of marketing management is about attracting and retaining customers by offering them desirable products that satisfy needs and meet wants. Marketing management in a customer-orientated business consists of five key tasks, as summarized in Table 1 (a synthesis from [6, 7, 9, 10]). Furthermore, marketing management literature mainly offer a listing of everything there is and was, with a lack of syntheses and theory generation (dynamics analysis of the marketing management paradigms are missing). Despite this, new thinking perspectives are presented in the marketing subject literature. In addition, there have been observed that academic paradigms differ from practitioner paradigms and several paradigms are living side by side, as can be seen in Table 2 that presents a synthesis on identifying changes over the past decades related to marketing management. As all such efforts it offers fuzzy rather than crisp categories with time frames that are fuzzy [4].

Table 1. The tasks of marketing management in a customer-oriented business (a synthesis from [5, 6, 8, 10, 11])

Marketing Task	Explanations
Identify target markets	Management have to identify those customers with whom they want to trade. The choice of target markets will be influenced by the wealth consumers hold and the business' ability to serve them.
Market research	Management have to collect information on the current and potential needs of customers in the markets they have chosen to supply. Areas to research include how customers buy (which marketing channels are used) and what competitors are offering.
Product development	Businesses must develop products and services that meet needs and wants sufficiently to attract target customers to wish and buy.
Marketing mix	Having identified the target markets and developed relevant products, management must then determine the price, promotion and distribution for the product. The marketing mix is tailored to offer value to customers, to communicate the offer and to make it accessible.
Market monitoring	The objective in marketing is to first attract customers - and then (most importantly) retain them by building a relationship. In order to do this effectively, they need feedback on customer satisfaction. They also need to feed this back into product design and marketing mix as customer needs and the competitive environment changes

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Table 2. Paradigms of marketing management (a synthesis from [4, 11])

Paradigm	Description
The '70s	Was dominated by American marketing management and the marketing mix ("the 4Ps"); all was standardized, mass-manufactured and mass-distributed consumer goods, business-to-consumer (B2C) marketing was a footnote. Services and relationships were absent. Customer centricity was stressed but on the conditions of suppliers who do something to customers.
The 1970 – 2000 period	Service marketing and management dominate and they were focusing on differences to goods marketing. The service encounter introduced interaction between service providers and customers, also noting that customers were partially present during the production and delivery of service. B2B marketing was also discovered and treated as different from B2C marketing. Customer Relationship Management (CRM), and one-to-one marketing were introduced, network and interaction concepts started to appear more frequently. In the 1980s quality management was rediscovered in business and excellence, value, and customer satisfaction were in focus. Marketing was claimed to be customer and relationship centric, but as before essentially based on the supplier's conditions: do something to the customers.
From the 2000s	It starts the era of commonalities, interdependencies and a systemic, stakeholder centric approach, addressing marketing complexity and theory generation. It is a period of Service-dominant (S-D) logic opens up for higher level theory, grand theory, and connects former fragments but also, discards outdated and a non-viable theory claims. It is supported by the practitioner-initiated service science, with an increased emphasis on many-to many networks and systems theory. A new marketing and service theory and a science of service based on co-creation of value in complex service systems is in the making: "do with others".

1.2. Product Concept From the Marketing Perspective

A product is defined as *"Anything that is capable of satisfying customer needs"*. This definition includes both **physical products** as well as services. The process by which companies distinguish their product offerings from the competition is called branding. For most companies, brands are not developed in isolation - they are part of a **product group** (or product line) which is a group of brands that are closely related in terms of their functions and the benefits they provide (e.g. Dell's range of personal computers or Sony's range of televisions). There are two main types of product brand [2, 4, 9]:

(1) **Manufacturer brands -** are created by producers and use their chosen brand name. The producer has the responsibility for marketing the brand, by building distribution and gaining customer brand loyalty. Good examples include Microsoft, Panasonic and Mercedes;

(2) **Own-label brands -** are created and owned by distributors. Good examples include Tesco and Sainsbury's.

The main importance of branding is that, done well, it permits a business to differentiate its products, adding extra value for consumers who value the brand, and improving profitability for the company. Businesses should manage their products carefully over time to ensure that they deliver products that continue to meet customer wants [6].

The process of managing groups of brands and product lines is called **portfolio planning.** Two models of product portfolio planning are widely known and used in business: the Boston Group Growth-Share Matrix, and GE Market Attractiveness model [1, 7, 9, 10].

Businesses need to regularly look for new products and markets for future growth. A useful way of looking at growth opportunities is the Ansoff Growth matrix, which suggests that there are four main ways in which growth can be achieved through a product strategy [7, 9, 10]:

(1) *Market penetration* - Increase sales of an existing product in an existing market;

(2) *Product development* - Improve present products and/or develop new products for the current market;

(3) *Market development* - Sell existing products into new markets (e.g. developing export sales);

(4) *Diversification* - Develop new products for new markets.

II. PRODUCT LIFE-CYCLE FROM THE MARKETING POINT OF VIEW

Businesses should manage their products carefully over time to ensure that they deliver products that continue to meet customer wants. The process of managing groups of brands and product lines is called portfolio planning [8, 12]. The stages through which individual products develop over time is called commonly known as the ***Product Life-Cycle***. The classic product life-cycle has four stages (illustrated in the Fig. 1): introduction; growth; maturity and decline [1, 8, 12, 14].

The life-cycle concept may apply to a brand or to a category of product. Its duration may be as short as a few months for a fad item or a century or more for product categories such as gasoline-powered automobile (e.g. natural resources). Product development is the incubation stage of the product life-cycle. There are no sales and the firm prepares to introduce the product. As the product progresses through its life-cycle, changes in the marketing mix

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usually are required in order to adjust to the evolving challenges and opportunities [1, 8, 9, 14, 15].

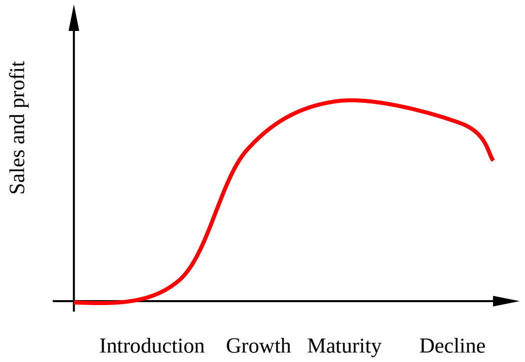

Figure 1. The classic product life-cycle curve

Introduction Stage - At the Introduction (or development) Stage market size and growth is slight. It is possible that substantial research and development costs have been incurred in getting the product to this stage. In addition, marketing costs may be high in order to test the market, undergo launch promotion and set up distribution channels. It is highly unlikely that companies will make profits on products at the Introduction Stage. Products at this stage have to be carefully monitored to ensure that they start to grow. Otherwise, the best option may be to withdraw or end the product [12, 14, 15].

During the introduction stage the primary goals is to establish a market and build primary demand for the product class. The following are some of the marketing mix implications of the introduction stage [1]:

1. *Product* – one or few products, relatively undifferentiated;
2. *Price* – generally high, assuming a skim pricing strategy for a high profit margin as the early adopters buy the product and the firm seeks to recoup development costs quickly. In some cases a penetration pricing strategy is used and introductory prices are set low to gain market share rapidly;
3. *Distribution* – is selective and scattered as the firm commences implementation of the distribution plan;
4. *Promotion* – is aimed at building brand awareness. Samples or trial incentives may be directed toward early adopters. The introductory promotion also is intended to convince potential resellers to carry the product.

Growth Stage - The Growth Stage is characterized by rapid growth in sales and profits. Profits arise due to an increase in output (economies of scale) and possibly better prices. At this stage, it is cheaper for businesses to invest in increasing their market share as well as enjoying the overall growth of the market. Accordingly, significant promotional resources are traditionally invested in products that are firmly in the Growth Stage [13, 14, 15]. During the growth stage the goal is to gain consumer preference and increase sales. The marketing mix may be modified as follows [1, 8, 9]:

1. *Product* – new product features and packaging options; improvement of product quality;
2. *Price* – maintained at a high level if demand is high, or reduced to capture additional customers;
3. *Distribution* – becomes more intensive. Trade discounts are minimal if resellers show a strong interest in the product;
4. *Promotion* – increased advertising to build brand preference.

Maturity Stage - The Maturity Stage is, perhaps, the most common stage for all markets. it is in this stage that competition is most intense as companies fight to maintain their market share. Here, both marketing and finance become key activities. Marketing spend has to be monitored carefully, since any significant moves are likely to be copied by competitors. The Maturity Stage is the time when the market as a whole earns most profit. Any expenditure on research and development is likely to be restricted to product modification and improvement and perhaps to improve production efficiency and quality [8, 12, 13, 14]. During the maturity stage, the primary goal is to maintain market share and extend the product life-cycle. Marketing mix decisions may include [1, 8]:

1. *Product* – modifications are made and features are added in order to differentiate the product from competing products that may have been introduced;
2. *Price* – possible price reductions in response to competition while avoiding a price war;
3. *Distribution* – new distribution channels and incentives to resellers in order to avoid losing shelf space;
4. *Promotion* – emphasis on differentiation and building of brand loyalty. Incentives to get competitors' customers to switch.

Decline Stage - In the Decline Stage, the market is shrinking, reducing the overall amount of profit that can be shared amongst the remaining competitors. At this stage, great care has to be taken to manage the product carefully. It may be possible to take out some production cost, to transfer production to a cheaper facility, sell the product into other, cheaper markets. Care should be taken to control the amount of stocks of the product. Ultimately, depending on whether the product remains profitable, a company may decide to end the product [5, 6, 7, 14]. During the decline phase, the firm generally has three options [5, 14, 15, 16]:

– Maintaining the product in hopes that competitors will exit. Reduce costs and find new uses for the product;
– Harvest it, reducing marketing support and coasting along until no more profit can be made;
– Discontinue the product when no more profit can be made or there is a successor product. The marketing mix may be modified as follows:

1. *Product* – the number of products in the product line may be reduced. Rejuvenate surviving products to make them look new again;

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2. *Price* – may be lowered to liquidate inventory of discontinued products. Prices may be maintained for continued products serving a niche market;
3. *Distribution* – becomes more selective. Channels that no longer are profitable are phased out;

Promotion – expenditures are lower and aimed at reinforcing the brand image for continued products.

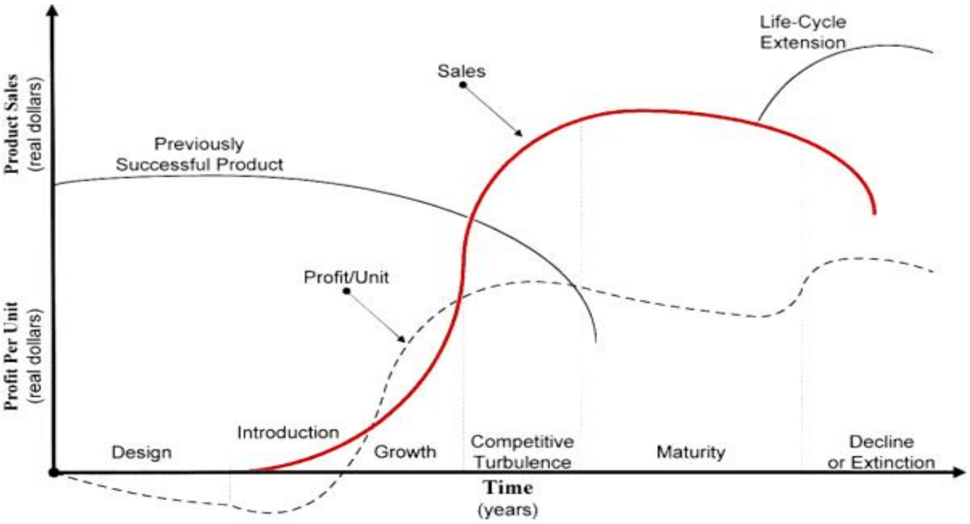

Figure 2. Generalized product life-cycle [7, 10]

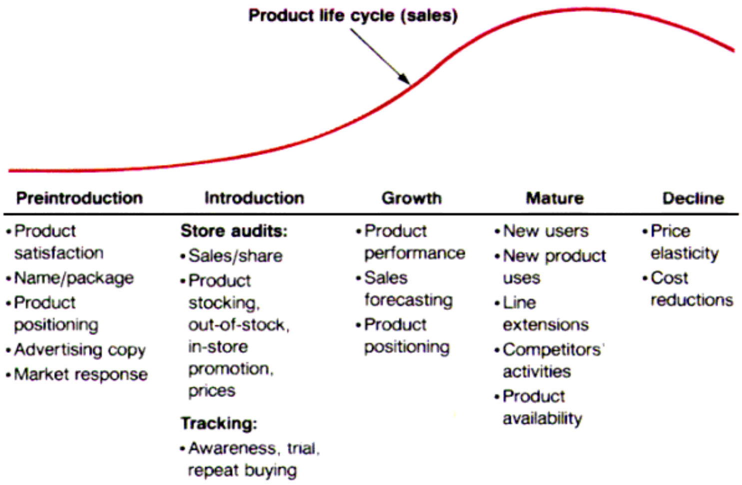

Figure 3. Types of research studied by stage of product life-cycle [7, 10]

Table 3. Examples of products and their different life-cycle's stages (related to the analysis done in 2005 [3])

Product life-cycle phase			
Introduction	**Growth**	**Maturity**	**Decline**
Third generation mobile phones	Portable DVD Players	Personal Computers	Typewriters
E-conferencing	Email	Faxes	Hand-written letters
All-in-one racing skin-suits	Breathable synthetic fabrics	Cotton t-shirts	Shell Suits
Iris-based personal identity cards	Smart cards	Credit cards	Cheque books

In Table 3 are presented some suggested examples of products that are currently at different stages of the product life-cycle.

The product life-cycle is a concept that describes the sales and profit margin of a given product category over a prolonged period, *from lust to dust*. The concept holds that a product's sales and profits change over time in a predictable manner-at least in the four distinct major stages of introduction, growth, maturity, and decline [15, 16].

Each of the curves in Fig. 2 represents the successive efforts of applied design methods. The figure shows, in a general way, the sequence of six possible steps fundamental to the product life-cycle analogy. A new product is *designed* and then *introduced* into the market. If wanted by the market, production and sales experience rapid *growth*. If successful, similar

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competitive products exit the market. Typically after three to five years, the market stabilizes and sales flatten to predictable patterns of slow growth or decline, seasonal demand, or other more complex cycles. The incandescent lightbulb is an example of a *mature* product. Eventually, even the incandescent lightbulb will be obsolete. This is process is called market *decline* or *extinction*.

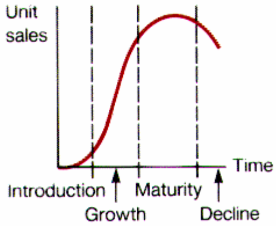
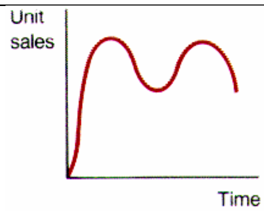
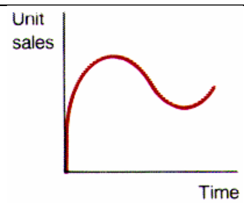
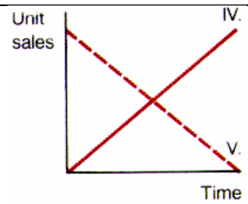
Typically when a product is mature, the profit per unit is predictably consistent and companies are reluctant to *invest* in design engineering. Such products are called *"cash cows,"* and may exist unchanged in the market for many years. Manufacturing engineering, however, is continuously engaged in reducing costs through production and assembly improvements, often called methods engineering.

When sales of a mature product consistently decline, it is often re-promoted, re-packaged, re-positioned, or re-priced and the product life-cycle is *extended*. How often have you observed the words "new and improved" on mature products like laundry detergent, vacuum cleaners, and oil filters? When traditional marketing efforts fail, management will often *invest* in engineering to design a similar product with newer methods and technologies. Alternatively, when there are many competitors in the market, companies with existing *growth* products actively develop future generations of replacement products. Growth products are exemplified by electronics and computer software markets such as the Pentium, and PentiumPro microprocessors [7, 10].

Activities Performed – Fig. 3 illustrates the types of feedback used by engineering during the various stages of product life-cycle. Engineers responsible for product or process improvement - usually a two year effort - must recognize what phase of the life-cycle the product is in to practice the most effective research.

Product Life-Cycle Curves - There are many ways to invest money. Design is simply one form investment. We invest money and resources in design activities because we expect a future return greater than we can receive elsewhere. It is important to understand product life-cycles curves to make the best use of engineering resources. The following figures characterize various industry products and their life-cycle curves. The amount of development money invested in a product intended for rapid market penetration, for example, is considerably less than for a one destined to a long-term stable, mature market [8, 9, 10]. A few examples of the product life-cycle curves are shown and described in Table 4.

Table 4 Examples of the product life-cycle curves [10]

#	Description	Product life-cycle curves
1	**Classical** product and project life-cycle sometimes called the “S” curve and is typical for consumer durable such as televisions, automobiles, and refrigerators and consumer non-durable such as cigarettes and food products. This is typical for industrial projects such as general engineering products, automobile components, petrochemicals, and industrial chemicals.	
2	**Cycle-Recycle** - exhibits increasing and decreasing sales with high and low plateaus. Typical for consumer non-durable such as drugs, household supplies, and personal-care products. Typical for high value added companies and gardening industries.	
3	**Cycle-Half Cycle** - reveals innovative maturity before replacement by next generation products.	
4 5	**Increasing Sales** - typical for growth and fad products having long market introductions such as machine vision systems. **Decreasing Sales** - typical for long-term mature products facing slow decline or extinction due to other competitive products in market.	

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(ii) Environmental, economic and social criteria. In the second class of criteria, only environmental and economic criteria are treated in the literature.

The present paper content is related to the product life-cycle perception on the market and the link with the technical approach (special the possibility to extend the (1) relation). We have presented different life-cycle curves that describe product's behavior on the market. Product concept from the marketing perspective has to be correlated with the design and manufacture perspective in a customer-oriented business. Marketing has a concrete representation of the product life-cycle by considering the time evolution of the sales and profit. Regarding Relation (1) we consider that LC_{phase} has to be consider from the marketing perspective, too.

$$P = f(LC_{phases}) = f(PreI, I, G, M, Dec) \qquad (2)$$

where P is the symbol for product / different products categorization;

LC_{phases} – Life-cycle phases;
PreI – Pre-introduction;
I – Introduction;
G – Growth;
M – Mature;
Dec – Decline.

The evaluation of the importance of product life-cycle phases is done by the marketing-mix evaluation (component analyses). This new perspective can develop new criteria that can be linked with the initial one (Fig. 6) because of the marketing orientation. The problems regarding categorizing products according to the importance of their life-cycle phases becomes interdisciplinary and they need to be solving in teams of specialists.

According to these new point of view we propose a model that can be represented as following:

$$P = f(LC_{phases}) = f(MP, PM, D, U, D/R) + \\ + f(PreI, I, G, M, Dec) \qquad (3)$$

These cumulated criterions will assure a competitive advantage of the product. A competitive advantage is an advantage over competitors gained by offering consumers greater value, either by means of lower prices or by providing greater benefits and service that justifies higher prices.

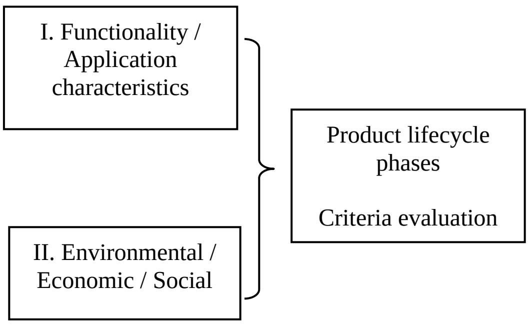

Figure 5. Criteria evaluation of the importance of product life-cycle

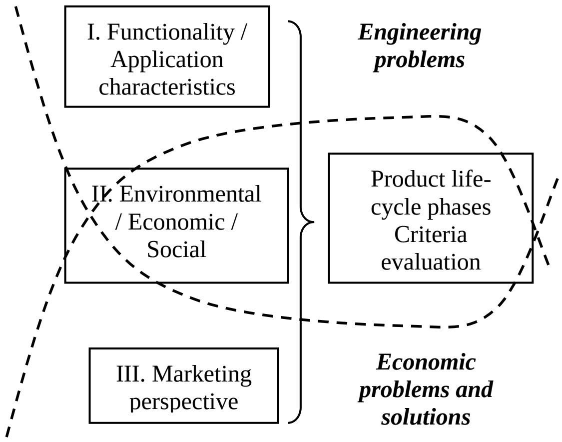

Fig. 6. New criteria evaluation of the product life-cycle importance

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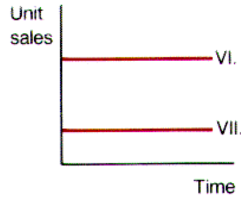
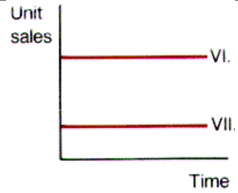
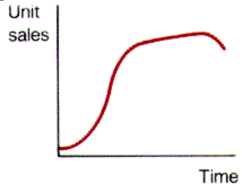
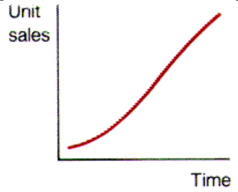
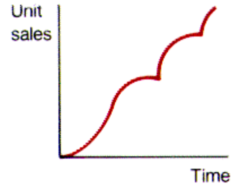
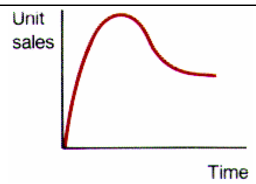
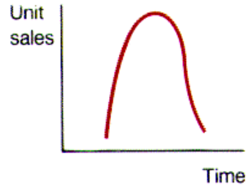
	High Plateau - mature product with more performance and features or lower production cost relative to competition.	
7	**Low Plateau**– mature product with less performance and features or higher production cost relative to competition.	
8	**Stable Maturity** – a variant of the classical life-cycle with products called “cash cows”. Every entrepreneur hopes for a stable mature product. This curve is typical for patentable products and processes.	
9	**Growth Maturity** - a variant of the classical life-cycle where a product exhibits continued growth over time (Figure 4g). This curve is typical for non-durable consumer such as paper and food products used across increasing populations of consumers.	
10	**Innovative Maturity** - exhibits sustained growth through product or process innovation. This curve is typical for durable consumer such as audio and computer equipment.	
11	**Growth-Decline-Plateau** - new and innovative products exhibit a "spike" in demand as consumers’ exhibit "me-too" habits. Typical of toys (recall the Super Soaker) and new technology such as compact disks and digital TV.	
12	**Rapid Penetration** - products with short life-cycles, high competitive turbulence, and emotional response. This life-cycle curve is typical for industrial chemicals.	

IV. CONCLUSIONS AND FINAL REMARKS

The context of our research is that we treated various issues related to explain product behavior according to the importance of their life-cycle phases on the market. For this aim, we have considered first the product life-cycle is decomposed into five main stages: materials production, product manufacturing, distribution, use and disposal/recycling. This approach is described from the technical point of view. The following relation shows the link between product category and the different life-cycle phases.

$$P = f(LC_{phases}) = f(MP, PM, D, U, D/R) \qquad (1)$$

where P is the symbol for product/different products categories;

LC_{phases} – Life-cycle phases;
MP - Material production;
PM - Product manufacturing;
D – Distribution;
U – Use;
D/R - disposal/recycling.

The presented stages reflect engineering problems or aspect. The design stage is not included in this decomposition as it concerns a mental activity.

The evaluation of the importance of product life-cycle phases is done according to specific criteria. Two different types of criteria are distinguished as main tools for the evaluation of the importance of the life-cycle phases of products (Fig. 1) [3, 10]:

(i) Functionality and application characteristic criteria and

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