

1. INTRODUCTION

The last few years have seen the development of a number of new methods aimed at improving the product development process. Silk and Urban (13), and Urban (14) propose such methods for consumer goods, Choffray and Lilien (4) for industrial products.

The approach followed by these authors consists in studying and quantifying the relationship that exists between potential users perceptions of the new product and of its major competitors and their preferences for these products. Once performed, the analysis allows:

- the identification of relevant product evaluation criteria, that is, the most important perceptual dimensions used by different segments of potential users to assess products in the class investigated, and
- the measurement of the impact on the new product's future demand of changes in its design and positioning.

Notwithstanding these contributions, empiricism still governs the development process for many new products. It is certainly the case for artistic work such as movies.

Several reasons may explain this situation. First, is the idea according to which creativity cannot be measured and, alone, determines the success of finished products. Second, many people, including movie producers, think that potential viewers needs are of a completely different nature than those leading to the purchase of say a consumer product. Third, we currently do not understand very well how individuals organize their leisures and what products and services compete in this respect.

The aim of this paper is to show how a systematic analysis of the way commercial movies are perceived by potential viewers allows a better understanding of the factors leading to their success. Our analysis proceeds as follows. First, we specify the role of perceptions in the viewers choice process and review the main factors that affect these perceptions. Then, we propose a systematic approach for movies evaluation that rests on the use of a multi-dimensional perceptual scale. Finally, we illustrate use of the procedure with a sample of forty films and discuss how the method could be used to improve the development process for new commercial movies.

2. THE ROLE OF PERCEPTIONS IN THE POTENTIAL VIEWERS CHOICE PROCESS

According to professionals, many factors do influence the way new movies behave on the market. To our knowledge, however, there has been no systema-

*) Associate Professor, and Head of the Marketing Science Group, ESSEC, France

**) Professor at the University of Lille II and ESSEC, France

tic study of these factors. Only a few authors Pras (11), and Angelmar and Pras (1), (2) have taken on the task of identifying the variables affecting the export sales of French movies and their success on the American market.

Here, we propose a conceptual model of the choice process of potential viewers that underlines the major factors influencing the different stages of this process (See Exhibit 1). This model builds on the hierarchy of effects paradigm proposed in the theory of consumer behavior (Howard and Sheth (8)). According to it, three main phases should be distinguished in the viewers choice process

1. Awareness of available movies and knowledge of their respective characteristics
2. Perception of available movies characteristics and formation of individual preferences
3. Choice among available movies.

Of course, even though the different phases of the choice process appear sequentially in the model, they need not to be that way in practice. In fact, the three phases are closely intertwined. Any logical sequence proceeds from the necessity to identify (a) the causal relationship between the different stages in the viewers decision process, and (b) the most relevant variables that affect the commercial success of movies.

In this paper, our focus is on potential viewers perceptual criteria as determinants of movies commercial success. Hence, we concentrate on formalizing step two of the decision process.

3. THE MEASUREMENT OF POTENTIAL VIEWERS PERCEPTIONS

How can perceptions be measured? Given our objective of quantifying the link between potential viewers perceptions and the success of films, we are quite restricted. One way is to proceed a posteriori, that is once commercial results are known. Otherwise, there would be a considerable lag between the measurement of perceptions — before commercial distribution of a film — and the availability of its commercial results.

Two approaches may be used at this level:

— **Microanalytic approach.** In this case, we would measure how a certain number of films are perceived by a sample of potential viewers. The films would be for purposes of the study, those distributed during a pre-specified period of time. The analysis would thus concentrate on relationship existing between an individual's perceptions of a film and the fact that he selected it or not during the relevant period.

— **Macroanalytic approach.** Here we would measure the overall perception of a film by a group of potential viewers. These perceptions would then be linked to aggregate measures of commercial success, such as total number of viewers, market share, etc . . .

EXHIBIT 1: A Conceptual Model of Potential Viewers Decision Process

Stage in the decision process

Main phases in the Choice Process

Influencing factors

COGNITION

- Awareness: knowledge of the film existence
- Knowledge of the film characteristics (Producer, actors, type ...)

AFFECT

- Attitude formation: film perception
- Evaluation: individual preferences formation

BEHAVIOR

Choice process: movie and theater

Promotional campaign prior to movie distribution (Press, radio, commercials)

Movie critic, word of mouth communication

Theater distribution and localization

- plain lines indicate direct influences
- dotted lines indicate indirect influences. For instance, when someone likes an actor, knowledge of the film existence and distribution in town is sufficient to trigger choice.

Here we suggest using the second approach as it offers sizeable advantages:

— First, it is not necessary to measure actual behavior (choice of films). Only aggregate measures of success are needed, and those are usually available.

— Second, a group level (e. g. average) perceptual profile for each film, reduces the incidence of "extreme" individual perceptions.

— Third, a larger number of films can be included in the analysis. Indeed, we are not limited to only those films that all respondents have seen during the chosen period.

— Fourth, the macroanalytic approach can be used with a smaller number of potential viewers as a result of the greater robustness of group level perceptual profiles.

For this study, a panel was formed with representatives of the movie industry, and filmgoers. A sample of forty films distributed in the Paris area during the last three years was selected. Perceptions were measured on a multi-dimensional scale, administered to each member of the panel for each film under study. Exhibit 2 provides this scale.

EXHIBIT 2: Perceptual Scale for Films Evaluation

| | Completely disagree | Disagree | Rather disagree | Rather agree | Agree | Completely agree | No opinion |
|--|---------------------|----------|-----------------|--------------|-------|------------------|--------------------------|
| 1. It contains a message | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 2. The music is particularly good | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 3. The script is poor | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 4. It deals with an outmoded theme | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 5. The direction is excellent | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 6. It makes one think | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 7. The music is poorly adapted to the photography | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 8. The film is intellectually satisfying | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 9. Many other films have already dealt with that theme | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 10. The photography is poor | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 11. The leading actor's performance is excellent | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 12. The film gets a message across | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 13. The film lets you "escape" | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 14. The title evokes the content well | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 15. The film lets you relax | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 16. It has no chance of being shown on television | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |
| 17. It makes you forget everyday problems | 1 | 2 | 3 | 4 | 5 | 6 | <input type="checkbox"/> |

4. RESEARCH METHODOLOGY

Our analysis comprises three main steps (See Exhibit 3). The first one concerns the measurement of panel members perceptions of each film using the multidimensional perceptual scale presented above. For each film i , a vector of perceptual scores

$$X_{ij} = \{x_{ij\ell}, \ell = 1..17\}$$

is obtained, corresponding to member j of the panel. The average perceptual profile of each film is then given by

$$\bar{X}_i = \frac{1}{n_i} \sum_{j=1}^{n_i} X_{ij}$$

where n_i corresponds to the number of panel members that gave their evaluation of film i .

Considerable empirical evidence suggests, however, that when an individual is placed in a choice situation, he does not consider all product attributes simultaneously in his evaluation process. Rather, he tends to rationalize and organize them into a smaller number of composite evaluation dimensions or criteria which in turn determine his preference and actual behavior. (Howard and Sheth (8), Hauser (6)).

Several methods may be used to isolate these evaluation criteria. Following Hauser and Koppelman (7) we use common factor analysis (Harman (5), Rummel (12)) as this method offers substantial advantages of interpretability, reproducibility, and predictive accuracy.

Put simply, common factor analysis "extracts" from the original perceptual scores a set of independent

EXHIBIT 3: Outline of Research Methodology

Stage

Method

Measurement of the perceptual profile of each film

Multidimensional perceptual scale administered to each member of the panel

$$X_{ij} = \{x_{ij\lambda} : \lambda = 1 \dots 17\}$$

Group level perceptual profile

$$\bar{X}_i = X_{ij}'s$$

Identification of evaluation criteria

Factor Analysis

$$x_{ij\lambda} = \sum_{k=1}^p a_{\lambda k} F_{ijk} + U_{ij\lambda}$$

Model development: linking perceptual profiles to aggregate commercial result

Multiple regression

$$M_i = g(\bar{F}_{ik} : k = 1 \dots p)$$

$$N_i = g(\bar{F}_{ik} : k = 1 \dots p)$$

linear combinations of these scores which best explain the observed pattern of intercorrelation. The original perceptual scores may then be written:

$$x_{ij\lambda} = \sum_{k=1}^p a_{\lambda k} F_{ijk} + U_{ij\lambda}$$

where $F_k : k = 1 \dots p$ are the evaluation criteria or common factors
and U_{λ} is the specific (unexplained) factor corresponding to variable X_{λ}

Once performed, this analysis allows us to compute the average score of each film on each evaluation criterion using the following relation:

$$\bar{F}_{ik} = \sum_{\lambda=1}^{17} b_{k\lambda} \bar{x}_{i\lambda}$$

where $b_{k\lambda} : \lambda = 1 \dots 17$

are the factor score coefficients corresponding to criteria k

and $\bar{x}'_{i\lambda}$ is the standardized average score of film i on the original perceptual item λ .

The last step in our analysis aims at quantifying the relationship existing between the commercial success of a film and the way it is perceived by potential viewers. To this end, we develop a model whose parameters are to be estimated statistically by a multiple regression analysis.

Here, we used the following two measures of commercial success for each film:

- market share M_i reached by the film in the Paris area, and
- length of distribution period (number of weeks N_i) in the Paris area.

The first variable offers considerable advantages over other measures such as the number of spectators as it eliminates problems arising from the seasonality of movie theaters frequentation. Moreover, when used in conjunction with the second variable — the number of weeks that the film runs — it gives a very precise measure of the degree of commercial success a film encounters in the Paris region. The data used here are published weekly by "Le Film Français", a professional journal for movie specialists in France.

Thus, two models will be developed:

$$M_i = g(\bar{F}_{ik} : k = 1 \dots p)$$

$$N_i = h(\bar{F}_{ik} : k = 1 \dots p)$$

where the analytical forms g and h respectively are specified in the next section.

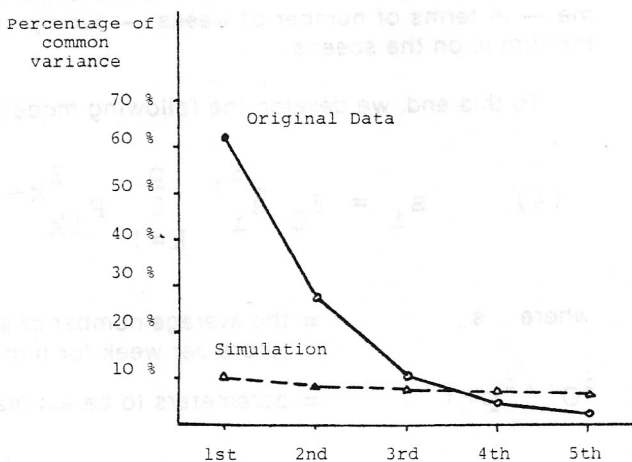
5. RESULTS OF THE ANALYSIS

5.1. Film Evaluation Criteria

The use of factor analysis to assess potential viewers evaluation criteria supposes that one determines first the number of dimensions to be retained in the analysis. To do so, we used the parallel factor analysis approach (Montanelli and Humphreys (9)) which consists in comparing the relative size of the eigenvalues of the correlation matrix of perceptual scores to the relative size of the eigenvalues which would have been observed if these scores had been generated by a random process¹⁾.

Exhibit 4 summarizes the results of this analysis. Beyond three factors, the percentage of the common variance extracted from the original perceptual data is smaller than the percentage which would be observed if the correlation structure had been purely random. A three factor solution therefore seems reasonable and is retained here for further analysis.

EXHIBIT 4: Determination of the Number of Aggregate Evaluation Dimensions



In order to assess the composition of each evaluation criteria, a principal factor analysis (Harman (5)) was performed, retaining only three factors. The solution is satisfactory from a statistical standpoint. The three factors retained explain 83% of the common variance²⁾ (See Appendix 1).

From an interpretation standpoint, the solution is quite interesting. The first evaluation criterion, which

1) A fortran program exists to perform this analysis and is presented in Choffray (3).

2) Common variance is defined here as the squared multiple correlation coefficients corresponding to each perceptual item.

corresponds to factor 1, regroups several items linked to the technical quality of the film as well as to its artistic quality. We thus call it simply "overall quality". The second criterion is clearly associated with relaxation and escape. We will call it the "relaxation" criterion. As for the third dimension it denotes the fact that a film communicates a message to its viewers and makes them think. We thus call it "intellectual satisfaction" (See Exhibit 5).

EXHIBIT 5: Interpretation of Potential Viewers Evaluation Criteria

Criterion 1

"Overall Quality"

- Quality and adaptation of music
- Value of the script
- Excellence of the direction

Criterion 2

"Relaxation"

- Chases away everyday problems
- Genuine relaxation
- Lets one escape from reality

Criterion 3

"Intellectual Satisfaction"

- Has a message and gets it across
- Makes one think
- Intellectually satisfying

Our analysis so far has enabled us to identify how potential viewers organize their perceptions into higher order evaluation criteria. The latter represent the basic dimensions along which movies are assessed. We still have to determine exactly how these criteria affect potential viewers preference and actual behavior. Let's now turn to that task.

5.2. Viewers Perceptions as a Determinant of Movies Commercial Success

5.2.1. Market-Share

The market share a film gets while it is distributed in the Paris area is an important indicator of its acceptance by potential viewers. Most professionals see in this measure the best predictor of the film success on the national level.

Market share rather than the total number of spectators expresses the success of a film relative to all other films during a given period. It presents the advantage of eliminating the influence of seasonal factors which certainly affect measures such as the total number of viewers.

In order to measure the impact of perceptual factors on market share, the following model was developed:

$$(1) \quad s_i = \alpha_0 S_i^{\alpha_1} \prod_{k=1}^p P_{ik}^{\alpha_{k+1}}$$

where

s_i = the total number of viewers for film i during distribution in the Paris area

S_i = total number of viewers for all films shown in the Paris area during the same period

P_{ik} = the **relative** perceptual score of film i on evaluation criterion k , namely

$$P_{ik} = \frac{\bar{F}_{ik} - \min_i \{\bar{F}_{ik}\}}{\min_i \{\bar{F}_{ik}\}}$$

F_{ik} = the score of film i on evaluation criterion k parameters to be estimated

$\alpha_0 \cdot \alpha_{p+1}$ (average factor score)

Expression (1) is equivalent to

$$M_i \left\{ S_i^{1-\alpha_1} \right\} = \alpha_0 \prod_{k=1}^p P_{ik}^{\alpha_{k+1}}$$

where M_i is film i market share.

The new dependent variable $M_i S_i^{1-\alpha_1}$

is an increasing or decreasing function of M_i depending on whether α_1 is smaller or greater than 1. The exact nature of this function, however, depends on the relative size of the market S_i during the period of film i 's distribution.

This indirect method of modeling market share offers several advantages.

- First, it eliminates problems linked to the estimation of a model whose dependent variable — market share — is defined over the interval 0—1
- Second, it offers in some way the "optimal" weighting of the dependent variable for statistical estimation. Here, this weight is a function of the total number of viewers S_i during the period of investigation, which appears to make much sense.

By taking logs on both sides of expression (1), we get:

$$(3) \quad \ln s_i = \ln \alpha_0 + \alpha_1 \ln S_i +$$

$$\sum_{k=1}^p \alpha_{k+1} \ln P_{ik}$$

whose parameters can be estimated by multiple regression.³⁾

Table 1 presents the results of this analysis for the forty films investigated. From a statistical standpoint the model appears to be sound. Fifty four percent of the total variance observed in the dependent variable s_i is accounted for by the movies evaluation on the three criteria "Overall Quality", "Relaxation" and "Intellectual Satisfaction". Moreover, use of relation (18) in appendix 2 indicates that this percentage provides a lower bound on the percentage of variance observed in the forty movies weighted market shares

$[M_i S_i^{0.49}]$ explained by our model.

From an interpretation standpoint, however, only α_4 , the parameter corresponding to the third evaluation criterion — intellectual satisfaction — is statistically significant. Its value indicates that weighted market share is inversely related to the film's evaluation on this dimension. In other words, our analysis tends to show that "message films" while intellectually satisfying, are poor market share builders!

As to the other two criteria they are not significantly related to weighted market share. Hasty conclusions, however, should be avoided. The absence of any systematic relationship might be due for example, to the particular composition of our sample.

5. 2. 2. Length of Distribution Period

While market-share is an important yardstick for appraising commercial success of a movie, an alternative operational dependent variable is the length of time — in terms of number of weeks — during which the film is on the screens.

To this end, we develop the following model:

$$(4) \quad s_i = \beta_0 \bar{s}_i^{\beta_1} \prod_{k=1}^p P_{ik}^{\beta_{k+1}}$$

where s_i = the average number of spectators per week for film i

$\beta_0 \cdot \beta_{p+1}$ = parameters to be estimated

the other variables, s_i and P_{ik} : $k = 1 \dots p$ are defined as before.

Model (4) may be written as:

$$(5) \quad n_i \bar{s}_i^{(1-\beta_1)} = \beta_0 \prod_{k=1}^p P_{ik}^{\beta_{k+1}}$$

3) In appendix 2 we prove that the estimators of parameters α_{k+1} , $\alpha=1, \dots, p$ are the same, independently of whether model (1) or (2) is used. We also measure the impact of the transformation performed on the dependent variable on the estimation accuracy.

TABLE 1: Estimation of the Impact of Perceptual Factors on Viewers Market Share

| | Constant | Total market | Overall quality | Relaxation | Intellectual satisfaction |
|-----------------------|------------|---------------|----------------------|-----------------|---------------------------|
| Parameter | α_0 | α_1 | α_2 | α_3 | α_4 |
| Coefficient (t stat.) | -0.281 | 0.507 5.87 | -0.124 (n.s)** | -0.129 (n.s) | -0.256 1.73 |
| Beta Coefficient | | 0.689 | -0.103 | -0.114 | -0.195 |
| $R^2 = 0.54$ | | | $F (4 : 36) = 10.42$ | | |

* n. s = not statistically significant

TABLE 2: Estimation of the Impact of Perceptual Factors on the Length of the Distribution Period

| | Constant | Average number of viewers | Overall Quality | Relaxation | Intellectual satisfaction |
|-----------------------|-----------|---------------------------|-----------------|------------------|---------------------------|
| Parameter | β_0 | β_1 | β_2 | β_3 | β_4 |
| Coefficient (t stat.) | 0.462 | 1.021 (11.75) | 0.034 (n.s) | -0.125 (1.67) | 0.054 (n.s) |
| Beta Coefficient | | 0.998 | 0.028 | -0.110 | 0.042 |
| $R^2 = 0.81$ | | $F (4,36) = 37.76$ | | | |

where n_i is the number of weeks film i runs in the Paris area.

The new dependent variable $n_i \bar{s}_i^{(1-\beta_1)}$ is an increasing or decreasing function of n_i , depending on whether β_1 is smaller or larger than 1. The term

$$\bar{s}_i^{(1-\beta_1)}$$

represents the "optimal" weighting of the number of weeks for purposes of statistical estimation. This weight takes into account the average number of viewers, \bar{s}_i for film i during its running.

Estimation results for this model, as summarized in table 2 are satisfactory. Use of relation (18) in appendix 2 indicates that the three perceptual criteria account for more than 81 percent of the observed variance in the weighted number of weeks. The statistical significance of the F-test suggests that the postulated relation between the number of weeks a film runs and the perceptions viewers have of the film is sound.

If we turn to interpretation, only the second evaluation criterion "relaxation" is statistically linked to the number of weeks a movie is run. The more a film is perceived as "relaxation" or as an instrument to forget ones daily worries, the shorter will be its period of distribution in the Paris area. This result is somewhat counter-intuitive. However, it might well underline the greater maturity of the French public and certainly appears as an a posteriori validation of the move many producers have made during the last few years towards more "intellectually" oriented movies.

As to the other evaluation criteria, they are not statistically related to the number of weeks a film runs. Once again, however, the size of our sample and/or its particular composition may have had an impact on these results.

6. DISCUSSION

In this paper we provided a new analytical framework to assess the determinants of commercial movies' success on the market. However our analysis has its own limitations and we point to some of these now which also provide challenging directions for further research.

First is the idea of **segmentation**. Some of our results as discussed earlier may appear somewhat counter-intuitive, namely the inverse relationship between the "relaxation" character of a movie and the length of its period of distribution in the Paris area. If we put aside potential biases during the data collection phase of our research, one factor that might account for observed results is audience heterogeneity. Further research should integrate this new dimension into the analysis. As an example, the number and/or the composition of potential viewers evaluation criteria might well vary both in time and across segments according to some rationale yet to be discovered. This constitutes undoubtedly a highly promising subject for future research in the area.

Second is the integration of such analytical procedures into a **decision support system** aimed at reducing the risks inherent to the movie development and market introduction process. Such a system should take into account not only perceptual variables as we did here, but also decision variables like the distribution system, anticipated promotional efforts and other measurable variables.

Once calibrated with a large sample of movies, such system might be used

- to evaluate the chances of success of a film as a function of its characteristics, and
- to support design decisions by pointing out to highly promising combinations of characteristics both in terms of positioning and movie conception.

7. CONCLUSION

This paper proposes a systematic approach to the analysis of the impact of perceptual factors on the market success of commercial movies.

The method we propose builds on some of the most recent developments in the fields of perceptions' measurement and market response assessment. A sample of forty films is used to assess the perceptual determinants of their commercial success both in terms of market share and length of distribution period in the Paris area.

Our analysis is still exploratory, however. More work has to be done to further validate our results at the segment level. The integration of our models into a managerially relevant decision support system is also a promising area for further work.

Notwithstanding these limitations, our analysis provides a first and decisive attempt to develop and use a systematic approach to the study of commercial films' market acceptance.

**APPENDIX 1: Results of the Common Factor Analysis
(VARIMAX Solution)**

| | Factor 1 | Factor 2 | Factor 3 |
|---|----------|----------|----------|
| 1. It contains a message | .44 | -.49 | .49 |
| 2. The music is particularly good | .78 | -.05 | -.01 |
| 3. The script is poor | -.73 | .12 | -.29 |
| 4. It deals with an outmoded theme | -.17 | .01 | .07 |
| 5. The direction is excellent | .70 | -.03 | .33 |
| 6. It makes one think | .42 | -.46 | .61 |
| 7. The music is poorly adapted to the photography | -.59 | -.09 | -.03 |
| 8. The film is intellectually satisfying | .50 | -.09 | .53 |
| 9. Many other films have already treated that theme | -.08 | .21 | -.32 |
| 10. The photography is poor | -.68 | .12 | -.06 |
| 11. The leading actor's performance is excellent | .49 | -.03 | .12 |
| 12. The film gets a message across | .37 | .02 | .65 |
| 13. The film lets you "escape" | .10 | .75 | -.05 |
| 14. The title evokes the content well | -.06 | .22 | .38 |
| 15. The film lets you relax | -.02 | .80 | -.05 |
| 16. It has no chance of being shown on television | .12 | -.25 | .46 |
| 17. It makes you forget everyday problems | -.07 | .88 | -.11 |
| Eigenvalue | 5.01 | 2.21 | 0.85 |
| Percentage of common variance* | 52% | 22% | 9% |

* Based on the first decomposition of the reduced correlation matrix.

APPENDIX 2

A. The equivalence of estimated parameters

Our objective here is to show that the parameters are the same regardless of the method

$$\alpha_k, k=2 \dots (p+1)$$

of estimation used, namely model (1) or model (2).

Since a multiplicative model can always be linearized by taking logs, we will prove the equivalence of the two methods for a linear model.

Let

$$(1) \quad Y = [z, x] \begin{bmatrix} \alpha \\ \beta \end{bmatrix} + \epsilon$$

where

Y is a (nx1) vector of observations on the response variable

z is a (nx1) vector corresponding to the first prediction variable

x is a [nx(m-1)] matrix containing the (m-1) remaining prediction variables

α is the coefficient for variable z

β is a [(m-1)x1] vector containing the coefficients for the (m-1) remaining prediction variables

ϵ is a (nx1) error vector

Using OLS, the estimator of $[\alpha, \beta]'$ is

(2)

$$\begin{bmatrix} \hat{\alpha} \\ \hat{\beta} \end{bmatrix} = \{ [z, x]^T [z, x] \}^{-1} [z, x]^T Y \quad (2)$$

where

$$(3) \quad \{ [z, x]^T [z, x] \}^{-1} = \begin{bmatrix} 1 & z^T x \\ z^T x & x^T x \end{bmatrix}^{-1} = \begin{bmatrix} b & q^T \\ q & B \end{bmatrix},$$

to simplify the notation.

We thus have

$$(4) \quad \hat{\alpha} = [b, q^T] [z, x]^T y,$$

the estimator of the first parameter in the regression.

The inverse of the reduced correlation matrix $(x^T x)^{-1}$ can be easily estimated. We have (Noble (10)).

$$(5) \quad [x^T x]^{-1} = B - \frac{1}{b} q q^T$$

with

$$(6) \quad q = -b [x^T x]^{-1} x^T z$$

Relation (6) may be written,

— $q/b = x^T x^{-1} x^T z$ which implies that the vector
— q/b is the estimator of the regression parameters of z on the $(m-1)$ remaining prediction variables.

Now, is the estimator of vector β affected by the method used?

By the direct method we get:

$$(7) \hat{\beta} = [q, B] [z, x]^T Y$$

$$(8) = q z^T Y + B x^T Y$$

By the indirect method we get:

$$(9) \hat{\beta} = [x^T x]^{-1} x^T [y - \hat{\alpha}] z$$

$$= [x^T x]^{-1} x^T y - \hat{\alpha} [x^T x]^{-1} x^T z$$

$$= [x^T x]^{-1} x^T y + \frac{\hat{\alpha}}{b} q$$

Using relation (4), (5) and (6), we get

$$(10) \hat{\beta} = [B - \frac{1}{b} q q^T] x^T Y + \frac{q}{b} [b, q^T] [z, x]^T Y$$

$$= B x^T Y - \frac{1}{b} q q^T x^T Y + q z^T Y + \frac{q}{b} q^T x^T Y$$

$$(11) = q z^T Y + B x^T Y$$

Comparing relation (8) and (11), it appears that the indirect method yields the same estimators as the direct method for the $(m-1)$ remaining prediction variables.

B. Impact of the Transformation on the Overall Precision of Estimation

Given:

$$(12) Y = [z, x] \begin{bmatrix} \alpha \\ \beta \end{bmatrix} + \varepsilon$$

with $[\hat{\alpha}, \hat{\beta}]^T$ the estimator of the parameters

$[\alpha, \beta]^T$

R^2 is given by

$$(13)$$

$$R^2 = \frac{[Y - z\hat{\alpha} - x\hat{\beta}]^T [Y - z\hat{\alpha} - x\hat{\beta}]}{[Y - \bar{Y}]^T [Y - \bar{Y}]}$$

For the reduced model

$$(14) [Y - z\alpha] = x\beta + \psi$$

R^2 is given by

$$(15) R^2 = \frac{[Y - z\hat{\alpha} - x\hat{\beta}]^T [Y - z\hat{\alpha} - x\hat{\beta}]}{[Y - z\hat{\alpha} - (\bar{Y} - z\hat{\alpha})]^T [Y - z\hat{\alpha} - (\bar{Y} - z\hat{\alpha})]}$$

Comparing (13) et (15) it appears that the numerator remains unchanged. Only the denominator is affected by the transformation.

Going from model (12) to model (14), the precision of the estimation will then improve if

$$(16) [Y - \bar{Y}]^T [Y - \bar{Y}] > [Y - z\hat{\alpha} - (\bar{Y} - z\hat{\alpha})]^T [Y - z\hat{\alpha} - (\bar{Y} - z\hat{\alpha})]$$

$$> [(Y - \bar{Y}) - \hat{\alpha}(z - \bar{z})]^T [(Y - \bar{Y}) - \hat{\alpha}(z - \bar{z})]$$

$$> (Y - \bar{Y})^T (Y - \bar{Y}) - 2\hat{\alpha}(Y - \bar{Y})^T (z - \bar{z})$$

$$+ \hat{\alpha}^2 (z - \bar{z})^T (z - \bar{z})$$

Which implies:

$$(17) \hat{\alpha}^2 \text{Var}(z) - 2\hat{\alpha} \text{Cov.}(Y, z)$$

or

$$(18) \rho(Y, z) > \frac{\hat{\alpha}}{2} \frac{\sigma(z)}{\sigma(Y)}$$

8. REFERENCES

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David R. Rink *
John E. Swan * *

ABSTRACT

Because Product life cycle (PLC) patterns vary, the marketing manager should not plan his marketing strategy around the classical cycle. Rather, he should forecast the likely type of PLC pattern for his specific product. This article presents information and a methodology that will aid the marketing manager in ascertaining his particular PLC type as well as formulating an appropriate marketing strategy.

Plan marketing strategy around the likely type of product life cycle for your product — not the classical cycle!

INTRODUCTION

The managerial use of the product life cycle (PLC) concept has been based on the assumption that marketing requirements for a product vary across its life cycle, and marketing planning should anticipate changes in marketing efforts as the cycle unfolds. It follows that the more accurately PLC stages could be forecasted for a product, the greater would be the planning value of the PLC concept.

Basic marketing texts as well as managerially-oriented articles have typically presented the classical product life cycle pattern of introduction, growth, maturity, and decline shown in Exhibit 1 (Type 1).¹⁾

1. E. Jerome McCarthy, **Basic Marketing: A Managerial Approach**, 4th ed., (Homewood, IL: Richard D. Irwin, 1971), pp. 345—348; Theodor Levitt, "Exploit the Product Life Cycle", **Harvard Business Review**, Vol. 43 (November-December 1965), pp. 81—94; Philip Kotler, **Marketing Management: Analysis, Planning and Control**, 2nd ed. (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1972), pp. 429—430; Robert Buzzell, "Competitive Behaviour and Product Life Cycles", In **New Ideas for Successful Marketing**, John Wright and Jac Goldstucker eds. (Chicago: American Marketing Association, June 1966), pp. 46—68; Donald Clifford, Jr., "Leverage in the Product Life Cycle", **Dun's Review of Modern Industry**, Vol. 85 (May 1967), pp. 62—70; Arch Patton, "Stretch Your Product's Earning Years: Top Management's Stake in the Product Life Cycle", **Management Review**, Vol. 48 (June 1959), pp. 9—14, 67—79.

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However, research concerning the product life cycle has resulted in strong evidence that actual PLC's vary to the extent that reliance on the classical PLC is likely to hinder, not help, marketing planning for many products. **The marketing planner needs to discover the specific type or types of life cycle patterns that are likely for his product.** The purpose of this article is to present research information on the PLC that will aid the marketing planner in better fitting the PLC concept to his specific industry and product.

This article will cover four basic topics. First, prior research on the PLC will be presented in order to demonstrate:

1. About a dozen different types of PLC curves have been found, including the classical shape. The marketing planner should not assume that the classical curve will fit his situation.
2. While a large variety of PLC curves exist, it appears that only a few basic curves are likely for any particular industry. Forecasting the likely PLC curve for a specific industry and product may not be too difficult provided the planner is aware of the typical types of PLC curves for his industry.

The second topic will concern some steps that may be useful in deriving PLC curves for an industry.

The third topic will develop the argument that the PLC is in part an uncontrollable factor to which the firm can only respond. But, to some extent, the PLC is also controllable by the firm, and it should be managed.

The fourth topic will be a discussion of fitting marketing strategy to **both** types of PLC curves as well as PLC stages. The literature to date has been primarily concerned with matching strategy to the PLC stage, not to types of PLC curves.

*) Associate Professor of Marketing, Department of Marketing, College of Business, Northern Illinois University, DeKalb, IL 60115 U. S. A.

***) Associate Professor of Marketing, Department of Marketing, College of Business, University of Alabama in Birmingham, Birmingham, AL 35204 U. S. A.