Extent and Impact of Incubation Time in New Product Diffusion

Rajeev Kohli, Donald Lehmann, and Jae H. Pae

This article examines the time between product development and market launch, and its relation to the subsequent diffusion of consumer durables. We find that this "incubation time" is long. Further, it is a useful predictor of the shape of the subsequent sales diffusion curve. Using the Bass model as a base, we find that the longer the incubation time, the lower the coefficient of innovation (p) *and the longer the time to peak sales. Further, using the incubation time in a Bayesian forecasting model significantly improves forecasts early in the life cycle.*

Introduction

The development of new products has rightly received considerable attention. In the published literature, considerable focus has been on two areas: (1) the development cycle, with particular emphasis on shortening the time from concept to developed product [17]; and (2) the adoption/diffusion pattern once significant sales begin [27]. However, the time between completion of product development and the beginning of significant sales has not been examined to the same extent. This article focuses on an initial analysis of this intermediate time period, which we term "incubation time." Specifically, we examine how long it is and whether it is useful in forecasting the subsequent diffusion curve.

Background

The pattern of growth, leveling off, and eventual decline has appeared for hundreds of products [3]. Considerable effort has gone into describing and forecasting the life cycle, as well as examining whether life cycles are shortening [5,6]. Of the many forecasting approaches, the Bass model [2] is the most prominent. Research building upon this model has proceeded for over 25 years [4,27]. An implicit assumption behind this work is that the time at which sales begin is known and that what occurs before this time is irrelevant.

Another direction of inquiry relates to cycle times, which have been decreasing dramatically in many industries [15,17]. Generally, the development cycle refers to the time between the beginning of product development and product introduction to the market. However, there is often a fairly long time that elapses between the completion of product development (invention), when someone attempts to sell the product, albeit on a small scale, and the beginning of substantial sales. For example, the first patent on a zipper was granted in 1893 and the patent for the "modern" zipper in 1913. Although attempts were made to sell the product, sales did not begin to take off until the 1930s [11]. In this article, we focus on the incubation time that elapses between invention and major market introduction (i.e., 1913 to 1930s).

Our interest in the incubation time is twofold. First,

Address correspondence to Donald R. Lehmann, Columbia University, Columbia Business School, Room 507, Uris Hall, 3022 Broadway, New York, NY 10027-6902.

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we are interested in incubation time *per se*. That is, we are curious about how long it tends to be and, to the extent it is possible, want to assess if at least some of the variance in it is explainable. Mrs. W. A. Cockran invented the first electric dishwasher in 1889, but the first product did not appear on the market until 1912. The trash compactor, on the other hand, was patented by Thomas Pratt and Michael Rieger in 1970 and was on the market the following year. Why is there a large time between invention and launch for some products? Here we examine whether the general product category makes a difference.

Second, we examine whether the length of the incubation time provides information that helps predict the shape (including time to peak) of the adoption curve. Is the incubation time shorter for products that diffuse faster after launch? Has this time become shorter in recent years? And does the knowledge of incubation time contain information that can be used to make better predictions about the adoption rate for a product?

Incubation Time and its Causes

The time before a really new product attains major sales can be divided in many ways, but seems best described in three stages. The first stage is product development, the time required from initial work on a project until the product is technologically complete. A large literature deals with this both in marketing and in research and development. The final stage is the mass diffusion of the product itself, often described by the Bass model [2], and has also been widely studied. Between these stages, however, is a third and little studied stage we call incubation. During this stage, attempts are made to sell the product, but for a variety of reasons sales remain extremely low. For example, low-alcohol beers existed for many years before, led by Miller Lite, sales finally experienced rapid growth. Put simply, the incubation period is the time between the essential completion of product development and the beginning of substantial sales for the product. The incubation period could be considered as part of the diffusion curve and diffusion models could be altered to have a long left tail. However, following Bass [2], the first year of sales has been operationalized as the year sales reach 1% to 3% of peak or cumulative sales. Also importantly, data on sales are often hard to find or non-existent in early years. When sales are very low, research firms and trade associations often do not bother to track them. Hence, because of a combination of tradition and data availability, we define the end of incubation time as the time when “noticeable” sales occur.

Why do sales remain low even when product development is essentially complete and marketing efforts are under way? There are several reasons, which can be described in terms of supply and demand restrictions. Supply can be restricted for a number of reasons, including:

1. While essentially complete, some fine-tuning product development may continue, which improves the perceived value of the product. Until this improvement is realized, the quality of the product may not yet be sufficient for mass adoption.
2. The developer of the product may not have sufficient financial resources to promote the product widely. This is particularly true of the small companies or individual entrepreneurs who often are the developers of really new products.
3. Legal requirements such as testing for ethical drugs

or tariffs for goods produced in other countries can prevent or retard sales.

4. The supply chain must be organized. Production (e.g., suppliers, and manufacturing) needs to be established, which can be non-trivial for really new products (e.g., silicon chip fabrication) so that obtaining sustained yields at an acceptable quality requires time. Perhaps even more crucial, (mass) distribution is a requirement for large-scale sales; many products follow a gradual rollout pattern.
5. When the developer of the product is a large firm, the firm may delay introduction so as not to cannibalize their existing product or possibly even fail to see the market potential for the product (as occurred with successively smaller disk drives for computers).

Similarly, demand may be retarded because:

1. Products require infrastructure or other complimentary products (e.g., cellular phones need transmission towers or satellites; computers depend on software).
2. Network externalities affect adoption (i.e., a picture phone is not of much use if the person you want to talk to does not have one).
3. Customers are under legal restrictions (i.e., contracts) to use older products.
4. Customers are under psychological restrictions to use older products (e.g., to justify expense/sunk cost).
5. As in the case of any innovation, a number of considerations can retard adoption, such as incompatibility, complexity, and financial risk [38].
6. The price is too high. Small sales volumes mean high prices and vice versa [16].
7. Potential customers expect quality to increase and price to drop [21] and, hence, wait partly to avoid making a "bad deal" and experiencing post-purchase transaction disutility [42].

Bass Model

Mahajan, Muller, and Bass [27] provide a detailed history of and prospects for the Bass model. The basic model is:

$$\frac{f(t)}{1 - F(t)} = p + qF(t) \tag{1}$$

where

$$F(t) = \frac{1 - \exp[-(p + q)t]}{1 + (q/p)\exp[-(p + q)t]} \tag{2}$$

is the distribution function describing the cumulative penetration at time t, $F(0) = 0$. The density function:

$$f(t) = \frac{(p + q)^2}{p} \quad \frac{\exp[-(p + q)t]}{[1 + (q/p)\exp(-(p + q))t]^2} \tag{3}$$

has a single peak, at:

$$t^* = \frac{1n\,(q/p)}{(p + q)} \tag{4}$$

which is interpreted as the time until peak sales. The constants p and q are commonly called the coefficients of innovation and imitation, respectively. The ability of this simple model to provide a good description of the adoption for several consumer durable products was first demonstrated by Bass [2] and discussed by Bass [3] and Bass et al [4]. The model has been enhanced in several ways, including:

1. the incorporation of marketing mix variables, such as price [37];
2. relaxing the symmetric nature of the diffusion process implied by Formula (1) [10];
3. improving parameter estimation methods [39,40];
4. allowing for a growing population of potential adopters [28];
5. comparing the forecasting ability of various models [35,36];
6. looking at international diffusion [12]; and
7. allowing for heterogeneity in the adoption probabilities [22,33].

As powerful a descriptive tool as the Bass model is, however, it is fairly unreliable as a predictor until several periods, typically years, of sales data are available [18,43]. Put differently, the Bass model is excellent at backcasting but is unreliable on its own for forecasting early in the life cycle. Consequently, efforts have been undertaken to use information other than sales to forecast the diffusion curve. Experience with including information on other products' diffusion patterns based on meta-analysis has proved promising [41,47,48]. Essentially, these Bayesian procedures combine prior estimates based on a meta-analysis of similar products and early sales data. In this article, we extend this approach by including incubation time as part of the prior.

Expected Relation Between Incubation Time and Diffusion

Most of the deterrents to adoption in the incubation period, such as product complexity, apply to the diffusion period as well. As a consequence, we predict that a long incubation period will be followed by a long time until peak sales are reached. More formally,

> **H1:** The longer the incubation time, the longer the time between the beginning of mass sales of a product and its attainment of peak sales.

If the incubation time is positively related to the time to peak sales, then it also must be negatively related to adoption by innovators or imitators. Bayus [6] reports a negative relationship between the coefficients of innovation and imitation. This, in turn, implies that we should expect to see a negative relationship between the incubation time and the coefficient of innovation, and a positive correlation between the incubation time and the coefficient of imitation. However, the effect of a smaller coefficient of innovation must be large enough so that the net effect of the two opposing factors is to increase the time to peak sales.

> **H2:** The longer the incubation time, the smaller the coefficient of innovation for the Bass model.

> **H3:** The longer the incubation time, the larger the coefficient of imitation for the Bass model.

Recent research by Bayus [6] suggests that the number of years between product launch and the attainment of peak sales does not appear to have decreased. Similarly, Jeuland [22] has shown that although the coefficient of imitation has increased, the coefficient of innovation has remained constant. Because the incubation time is related to (and has been modeled as) a long left tail of the sales curve where p is close to zero, we hypothesize:

> **H4:** Incubation time has not changed over time.

Data

We examined data for 32 consumer durables in three broad categories: major appliances (10 products), housewares (11 products), and consumer electronics (11 products). The products are listed in the first column of Table 1. All these products have been studied previously in the context of the diffusion of innovations.

Our study is restricted to successful consumer durables introduced in the United States. We do so in this initial study on incubation time for three reasons. First, it is harder to get data on “failures,” that is, products that do not grow in sales over time. Second, managers assume their product will succeed (why else would they launch it?) and, hence, often are interested in how a product will do if it succeeds. Finally, by using these products, we make our results comparable to those used in other studies in this area. Obviously generalizations to other types of products and geographic locations are not demonstrable given our data. Still, because our main point is to introduce the concept of incubation time (rather than provide a single definitive study on it) and because consumer durables represent a major category of products, this seems appropriate as a first step.

We select the year in which the last patent on a product was filed prior to its launch as the year of completion of product development and, hence, the beginning of incubation time. Whereas earlier patents for similar products or subunits or technologies often have been filed (for example, Unilever introduced a new, significantly improved laundry detergent in Europe based on 34 patents that it received over a period of 10 years), we use the most recent date to obtain a conservative estimate of incubation time. As discussed earlier, we define year of launch as the year in which substantial sales data begin. The Appendix lists the sources from which the dates of invention, market launch, and peak sales were obtained.

The measures we use for the completion of product invention and the beginning of sales are both errorful. For example, because the year substantial sales begin is based on historical records, any errors in the sources are reflected in our measure. Similarly, pinpointing when a product is finished being invented is difficult because most products continue to evolve over time. If these errors produce sufficient random error in the measurement of incubation time, then any measured correlation of incubation time to other variables will be biased downward. For that reason, this study can be seen as a conservative analysis of the impact of incubation time.

For each product, the coefficients of innovation and imitation were estimated using nonlinear least squares (NLS) [40]. NLS has the advantage that it can provide estimates with censored data, which is useful because the market penetration for a product seldom is known from the time substantial sales begin. It also is the most widely used and recommended procedure [26], although recent work suggests it may produce biased

Table 1. Incubation Time, Diffusion Coefficients, and Time to Peak Sales for Products Used in the Study

Product	Year Invented	Year Launched	Incubation Time (Years)	Time to Peak (Years)	$p(e + 04)$	$q(e + 02)$	Data Used
Appliances							
Dishwasher	1889	1912	23	49	0.2	12.66	1922–1961
Room AC	1911	1933	22	26	3	38.9	1940–1961
Microwave	1945	1955	10	32	2	17.54	1970–1989
Clothes Dryer	1930	1939	9	17	4	38.82	1947–1960
Refrigerator	1905	1913	8	24	1.8	30.48	1921–1939
Waste Disposal	1929	1935	6	24	9.8	18.04	1947–1960
Freezer	1924	1929	5	24	29.9	13.25	1946–1965
Electric Range	1915	1919	4	11	79.8	41.1	1921–1934
Clothes Washer	1906	1910	4	26	12	7.69	1922–1940
Trash Compactor	1970	1971	1	3	460	26.51	1971–1982
Housewares							
Blender	1932	1946	14	23	0.8	34.76	1950–1971
Mixer	1910	1923	13	33	3.2	16.57	1933–1958
Food Processor	1960	1971	11	9	4.9	67	1976–1983
Shaver	1923	1931	8	25	2.1	26.36	1940–1961
Automatic Coffee Maker	1930	1937	7	19	45	15.03	1949–1961
Heating Pad	1914	1918	4	11	101.6	14.53	1922–1937
Fluorescent Lamp	1934	1938	4	28	8.2	5.46	1945–1967
Broiler	1934	1937	3	17	11.1	15.6	1946–1956
Can Opener	1955	1957	2	12	107.1	28.9	1960–1971
Vacuum Cleaner	1907	1908	1	21	14.2	29.41	1922–1934
Electric Knife	1963	1963	0	2	967	7.03	1964–1976
Electronics							
VCR	1958	1975	17	—	22	35.76	1976–1992
CD Player	1969	1983	14	—	17.1	35.8	1983–1992
PC	1962	1975	13	—	30.6	25.32	1975–1992
Cellular Phone	1970	1983	13	—	9.2	49.6	1984–1992
Radio	1910	1922	12	25	16	23.57	1922–1951
B&W TV	1927	1939	12	26	57	14.77	1946–1970
Digital Watch	1962	1971	9	12	80	36.29	1974–1984
Color TV	1949	1954	5	14	1.1	63.96	1954–1970
Calculator	1967	1972	5	13	118.3	29.35	1972–1986
Cassette Deck	1961	1964	3	17	18	32.16	1974–1984
Video Game	1972	1975	3	7	197.9	30.66	1978–1984

results, especially when few periods of data are used [46].

Results

Duration of Incubation Time

The incubation time for the 32 products is shown in Table 1. It has a mean of 8.3 and a median of 7 years. The electric slicing knife had the shortest incubation time (0 years) and the dishwasher the longest (23 years). The distribution of the incubation time is given in Table 2. Table 3 shows some differences among product categories. Major appliances have the longest

Table 2. Distribution of Incubation Time

Incubation Time (years)	No. of Products	Percentage of Products
0–5	14	44
6–10	7	22
11–15	8	25
16–20	1	3
21+	2	6

Table 3. Mean Values for Incubation Time and Diffusion Parameters

Product Category	No. of Products	Mean Incubation Time (years)	Mean Time to Peak Sales (years)	Mean Coefficient of Innovation	Mean Coefficient of Imitation
Major Appliances	10	9.2	23.6	0.0059	0.2450
Housewares	11	6.1	18.2	0.0115	0.2369
Consumer Electronics	11	9.6	16.3[a]	0.0052	0.3429
All Products	32	8.3	19.6	0.0076	0.2759

[a] Based on the seven products listed in Table 1 that have achieved peak sales.

average time to peak. However, this is influenced largely by dishwashers, which took 49 years to attain peak sales. Excluding dishwashers, the time to peak for this category has a mean value of 20.8 years, which is close to the grand mean of 19.6 years.

Diffusion Parameters

The means and standard deviations for the coefficient of innovation, the coefficient of imitation, and the time to peak are reported in Table 3. Across products, the average value is 0.0076 for the coefficient of innovation, 0.2759 for the coefficient of imitation, and 19.6 years for the time interval between market launch and the attainment of peak sales. These statistics are similar to those reported by Bass [2] and Sultan et al [41]. The first study, which examined 11 consumer durables, reported mean values of 0.0167 and 0.33 for the coefficients of innovation and imitation, respectively. The second, which studied 213 applications, reported mean values of 0.03 and 0.38 for the coefficients of innovation and imitation. Thus, the products included in this study are similar in terms of the estimated diffusion parameters to those examined in earlier studies.

The coefficient of innovation is twice as large for housewares as it is for major appliances and consumer electronics. This makes sense, because housewares are less expensive and complex than the other two types of products. Housewares and major appliances have similar coefficients of imitation. By contrast, consumer electronics have a low coefficient of innovation and a high coefficient of imitation, perhaps because the consumer value for many of these products (e.g., television [TV], video cassette recorder [VCR], compact disc [CD] player) increases with the number of adopters and the availability of complementary products (e.g., TV programming, video stores, and CDs).

Relation between Incubation Time and Diffusion Parameters

We begin by examining the correlation between incubation time and each of the following variables: (1) product category, identified by two dummy variables that reflect the incremental incubation time for consumer electronics (c_1) and major appliances (c_2) over housewares; (2) the number of years between market launch and the attainment of peak sales by a product; (3) year of introduction (to see whether there has been any potential shortening of the incubation time); (4) the coefficient of innovation (p); and (5) the coefficient of imitation (q).

Consistent with hypotheses H1 and H2, the correlations reported in Table 4 indicate that incubation time has (1) a positive association with the time to peak sales and (2) a negative association with the coefficient of innovation. While the relationship be-

Table 4. Correlations Among Variables

	Incubation Time	Time to Peak Sales	If Consumer Electronics	If Major Appliances	p	q
Incubation Time						
Time to Peak Sales	0.68					
If Consumer Electronics	0.17	−0.19				
If Major Appliances	0.11	0.30	−0.49			
p	−0.41	−0.57	−0.10	−0.06		
q	0.18	−0.37	0.33	−0.14	−0.49	
Year of Launch	0.02	−0.61	0.60	−0.40	−0.13	0.50

tween incubation time and the coefficient of imitation is positive, it is not significant and, thus, hypothesis H3 is not strongly supported. Consistent with hypothesis H4, there is no relationship between incubation time and the year of introduction, suggesting that innate innovativeness is not increasing. Finally, as expected, there is a negative correlation between the coefficients of innovation and imitation. Time to peak sales has decreased over time because, as in Jeuland [22], the coefficient of imitation increases over time.

Using Incubation Time to Predict the Adoption Pattern

To establish the impact of incubation time on parameters of the diffusion curve, we first ran ordinary least squares regressions of p and q versus product category (two dummy variables), incubation time, year of launch, and two-way interactions among the variables. We then reran the regression including only the significant variables (Table 5). Interestingly, the year of introduction, by itself, does not a provide useful incremental predictive value for either p or q. The coefficient of innovation was significantly negatively related to incubation time ($p < .05$), significantly even more so in recent years, although the effect is less negative for consumer electronics products. Overall, the model explained 43% of the variance in the coefficient of innovation. By contrast, the coefficient of imitation was not directly related to incubation time. The impact of incubation time was more negative for electronics products, and incubation had a more positive impact on imitation in recent years. Thus, in spite of the errorful nature of the measure of incubation time, it provides a useful prediction of the eventual adoption pattern.

The prediction of sales is both important and difficult in the early years after the launch of a product. Predictions obtained using the Bass model are generally poor, with limited data [18,40]. In the early years after product launch, perhaps the best approach is to use a Bayesian combination of the forecasts obtained from meta-analysis [44] and the data [25,31,41]. The potential value of incubation time for predicting the rate of market penetration was examined by comparing four models. The four models of interest were: (1) meta-analysis priors based on (a) only the category average and launch year and (b) the category average and launch year plus incubation time, and (2) Bayesian combinations of meta-analyses and data-based forecasts using the two different meta-analyses in (1). For purposes of comparison, a fifth model based solely on the data also was used for forecasting.

Sales data for 4, 6, and 8 years after launch were used to estimate the Bass model for the 32 products. Predicted penetration levels for 1, 2, and 3 years out were generated using the estimated model. The percentage deviation between the actual and predicted penetration levels then was computed for each cell of the design (years of data by forecasting models by years ahead for the forecast). Analysis of variance showed all three main effects plus the interaction between forecasting method and years ahead for the forecast were significant at $p < .001$. Not surprisingly, the number of years ahead the forecast is made noticeably and significantly decreases forecast accuracy. The interesting results involve the significantly different accuracies of the various forecasting methods.

Table 6 compares the average accuracy of the different forecasts. The Bayesian forecast using the meta-analysis prior, which incorporates incubation time is more accurate than the other methods, as a test of contrasts using Scheffe's method indicates that it predicts better than the other methods, separately or pooled ($p < .05$). Forecasts based on the meta-analysis priors using incubation time alone are more accurate than the Bayesian forecasts obtained by combining the meta-analysis priors with the category variables with actual data. Further, incubation time is significantly related to the time until sales reach 5% and 10% of their peak sales (Table 7).

Table 5. Significant Regression Predictors of Diffusion Parameters

Source	p	q
Constant	.0267	.1802
Incubation Time	−.0012	
Incubation Time × Electronics	.0006	.0022
Launch Year × Electronics	−.000028	
Incubation Time × Launch Year	−.00008	.00026

Table 6. Percent Error by Forecast Method

Method	Average Percent Error
Data-Only Forecast	34.3
Meta-Analysis Incorporating Product Category and Launch Year	37.8
Meta-Analysis Incorporating Incubation Time	31.5
Bayesian Forecast Incorporating Product Category and Launch Year	33.1
Bayesian Forecast Incorporating Incubation Time	26.1

Table 7. Correlation with Time to a Percentage of Peak Sales

	Time to 5% of Peak Sales	Time to 10% of Peak Sales
Time to 10% of Peak Sales	0.96	
Time to Peak Sales	0.51	0.59
Incubation Time	0.56	0.58
If Consumer Electronics	−0.17	−0.20
If Housewares	0.29	0.29
p	−0.33	−0.40
q	0.22	0.17
Launch Year	−0.13	−0.20

These results suggest that the incubation time contains useful information for improving the predictions obtained from the Bass model of eventually successful consumer durables, the marginal improvement over the other methods decreasing as more data are obtained for the estimation of the model. Interestingly, priors based on category variables alone do almost as well, and priors based on incubation time slightly better than, the data-based forecasts early in the product life cycle, which emphasizes both the unreliability of sales data and the value of empirical generalizations.

Case Analysis

One way to at least develop hypotheses about what occurs during incubation time is to examine the outliers (i.e., those products with especially long or short incubation times). The product with the longest incubation time was dishwashers. Several circumstances are associated with it, including (a) how early it was invented and launched (the earliest in the sample), (b) improvements subsequent to launch (e.g., an improved pullout rack system to increase convenience, its principle advantage), (c) the need for supporting products (special soap), and (d) the need to overcome compatibility issues with respect to cleanliness and social roles. The next longest incubation occurs for room air conditioners (ACs) (22 years) and VCRs (17 years), neither of which shares all four of the characteristics of dishwashers. Whereas VCRs share the need for complementary products (i.e., recorded tapes), they are a relatively recent innovation. Room ACs, by contrast, had little need for complementary products.

At the other end of the spectrum, the electric knife, trash compactor, and vacuum cleaner took a year or less to reach substantial sales. These, too, had variations in when they were invented. They did share the lack of need for complementary products but differed in eventual penetration levels and price, among other attributes. Thus, although examining single innovations may generate some hypotheses, no obvious law-like generalizations emerge.

Conclusion

This article has focused on a component of a product's life, the incubation time, which has received relatively little attention. It is particularly interesting that incubation time is fairly long, sometimes longer than the time to develop/invent the product. Unlike the time to develop a workable product, and the time while sales grow to their peak, the incubation time and what happens during it is relatively under-researched. Our results suggest that it contains systematic variance, is related to the coefficients of innovation and imitation and the peak time to sales, and can be a useful piece of information for predicting the subsequent growth of a product.

Because this is an initial study of incubation time, no theory exists to explain it. Based on Table 1, however, several things seem related to having a longer incubation time, most notably, requiring a change in behavior pattern (incompatible products). Dishwashers and room ACs have the longest incubation times and lead to changes in behavior pattern (e.g., changing the task structure of the family for dishwashing, drying, etc.). Within electronics, an incubation time of 10 years separates products relying on new software or user networks from the others, excluding the tape deck. We think future research should address general underlying constructs that may relate to incubation timem such as those proposed by Rogers [38] and analyzed by Holak and Lehmann [20].

Our results are based on consumer products in the United States. Of course, it is impossible to generalize broadly about the extent of incubation time in other areas. Still, conversations with practitioners in such diverse fields as chemicals and food products suggest 10 years is a ball-park estimate for incubation time. One obvious direction for future research is to extend this work to other products, services, and regions of the world. Another fairly obvious direction for research is the development of explanations for the variance in incubation time (i.e., is the time for dishwashers long because it was non-essential, raised health concerns, involved a change in the social structure of the household, ...?). Perhaps most obvious is the need to understand what goes on and what, if anything, can be done to shorten it.

Less obvious are the implications of current efforts to shorten cycle time. Will shortening cycle time shorten incubation time and, hence, time to peak sales, or, by less well preparing both the product and the market for it, lower market potential and/or increase time to peak sales? More generally, for discontinuous innovations/really new products, is incubation time a natural phenomenon that must be endured or an inconvenience to be done away with?

Finally, what is learned during this period? It would be wonderful if we could present a comprehensive picture of what goes on during incubation (i.e., what causes it) and whether shortening it speeds or delays adoption and profits. Unfortunately, we cannot. As an early study in this area we are content with (a) establishing its existence and variability and (b) demonstrating that it is significantly related to the subsequent diffusion process. Although we have offered several explanations for its existence (e.g., need for complementary products), development of a comprehensive theory of its existence and the effectiveness and impact of attempts to shorten it clearly are needed. We view this as fertile ground for future research. In summary, this article provides an initial look at incubation time. Initial results are both interesting and intuitive. As a complement to work studying the sales curve once growth begins, studying the time before sales grow seems an activity whose time has come.

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Appendix

Sources of Invention and Market Introduction

1. **American Heritage**
   Invention: Electric Range [1], Toaster [19]
   Market Introduction: Toaster [19]
2. **Domestic Technology** [19]
   Invention: Dishwasher (p. 203), personal computer (PC) (p. 304), Refrigerator (p. 63), Shaver (p. 213), Washer, (p. 424), Waste Disposal (p. 227)
   Market Introduction: Clothes Dryer (p. 207), Dishwasher (p. 206), Electric Range (p. 119), Fluorescent Lamp (p. 278), PC (p. 304), Refrigerator (p. 63), Vacuum Cleaner, (p. 200), Waste Disposal (p. 227)
3. **Electronic Inventions and Discoveries** [8]
   Invention: Black-and-White (B&W) TV (p. 28), VCR (p. 28)
4. **An Encyclopedia of the History of Technology** [30]
   Invention: Digital Watch (p. 697)
   Market Introduction: B&W TV (p. 746), Digital Watch (p. 697)
5. **The Harwin Chronology of Inventions, Innovations, and Discoveries** [7]
   Invention: Fluorescent Lamp (p. 1938), Video Games (p. 1972)
   Market Introduction: Video Games (p. 1975), Washer (p. 1906)
6. **The Housewares Story** [24]
   Invention: Blender (p. 271), Broiler (p. 282), Can Opener (p. 324), Coffee Maker (p. 246), Roaster (p. 182), Steam Iron (p. 238)
   Market Introduction: Broiler (p. 282), Coffee Maker (p. 246), Electric Knife (p. 313), Roaster (p. 182), Steam Iron (p. 238)
7. **Inventions and Discoveries** [14]
   Invention: Cassette Tape Deck (p. 200), Cellular Phone (p. 201), Color TV (p. 201), Freezer (p. 101), Mixer (p. 100), Radio (p. 200), Room AC (p. 101)
   Market Introduction: Cassette Tape Deck (p. 200), CD Player (p. 200), Cellular Phone (p. 201), Color TV (p. 201), Mixer (p. 100), Radio (p. 200), Shaver (p. 104), VCR (p. 201)
8. **Marketing Letters** [6]
   Market Introduction: Blender, Freezer, Heating Pad, Trash Compactor
9. **Merchandising Week** [29]
   Market Introduction: Room AC (Feb 28, 1972)

10. **Milestones in Science and Technology** [32]
Market Introduction: Electric Fan (p. 42)
11. **Official Gazette of the Patent Office** [34]
Invention: Electric Fan (1891), Electric Knife (1965), Heating Pad (1915), Trash Compactor (1972)
12. **The World Almanac Book of Invention** [13]
Invention: Food Processor (p. 152), Hair Dryer (p. 160)
Market Introduction: Food Processor (p. 152), Hair Dryer (p. 160)
13. **World of Invention** [45]
Invention: Calculator (p. 112), CD Player (p. 154), Clothes Dryer (p. 145), Microwave Oven (p. 422), Vacuum Cleaner (p. 657)
Market Introduction: Calculator (p. 112), Can Opener (p. 118), Microwave Oven (p. 422)