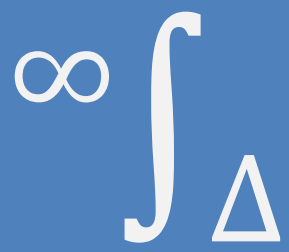

Understanding the Future

Daniel Research Group

The Times are a-Changin'

July, 2011

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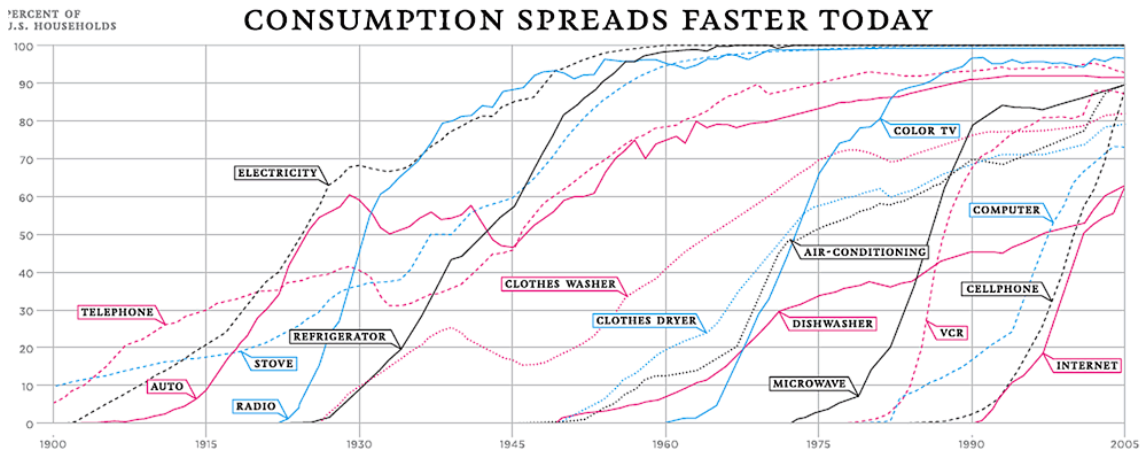
Stephen J. Daniel is founder and president of **Daniel Research Group,** a technology market research firm specializing in the design, development and application of market models and forecast. The following article contains material drawn from his book, *Understanding the Future, A Practical Guide to Designing and Developing Context Specific Segmented Forecasts and Models For Technology Markets*

One of the most important management metrics for technology vendors is the time it takes for a new product or service to attain specific market penetration levels. The most common metric is the take-up time, usually defined as the number of months and/or years to go from x% penetration of the market to y% penetration of the market. Forecasting take-up time with high confidence is required for many critical business decisions.

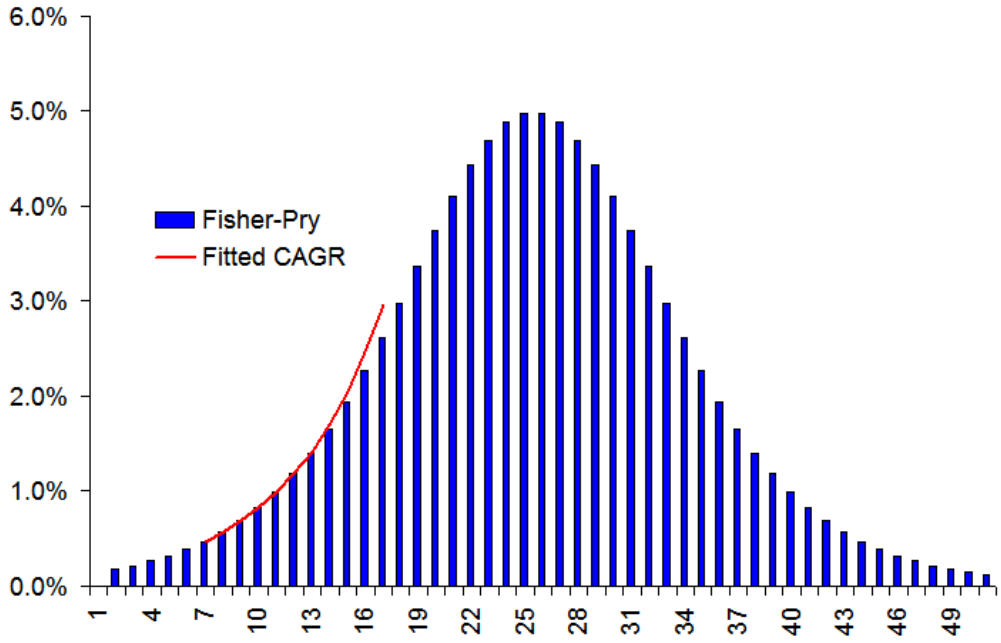
Take-up times are getting shorter and the rate of change is accelerating in both the enterprise and consumer markets. This acceleration is creating a new set of development and marketing challenges for technology vendors and a need for new approaches to forecasting market sizes, trends and segmentations.



As this chart first published by the New York Times in 2008 clearly shows, the cumulative curves are getting steeper and the market lives are getting correspondingly shorter. More important, this is a relatively recent change. It took approximately 50 years for the architectural and construction technologies responsible for the building of Gothic Cathedrals to spread in Europe. It took about 50 years for steam power to replace human and animal power; about 50 years for canals to spread in the United States; about 50 years for railroads to replace canals; and about 50 years for electrical power to replace steam. For over 1000 years, the time it took for category-level technological innovation to spread remained at approximately 50 years.

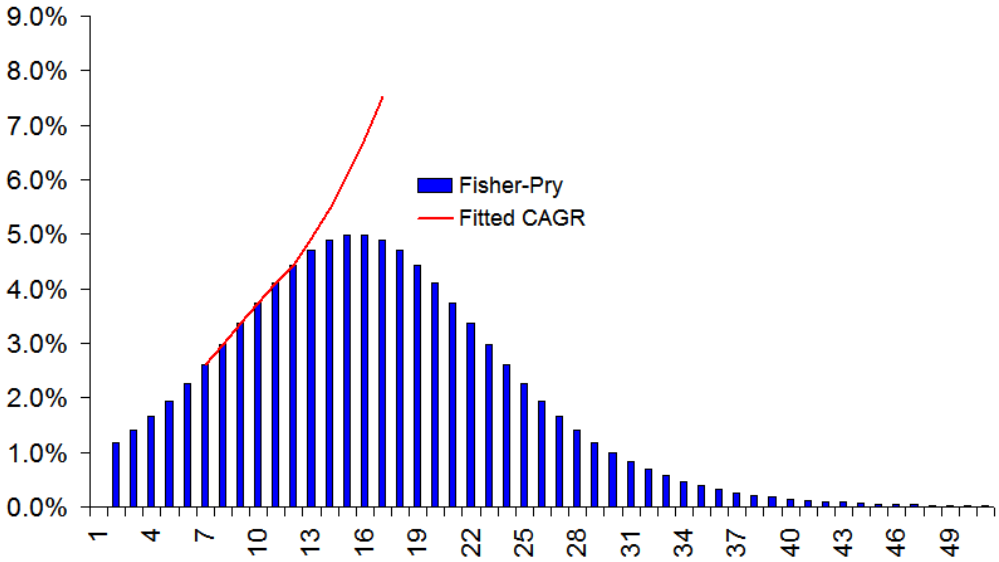
So what has changed? Why are market penetration rates accelerating? Most analysts will answer, "because for the first time since the invention of the printing press, changes to the communication process itself have accelerated the rate that information about innovations diffuse in the marketplace." While this is true, it does not explain the real drivers and factors that define today's markets. Before addressing the real causes it is necessary to understand the major problem that this change has created for the technology market forecaster.

The most common process that many forecasters use to construct their forecasts is to fit a curve to historical periodic unit data and extrapolate that curve. Most of the time the curve is some form of the exponential function such as a Compound Annual Growth Rate (CAGR). For most purposes this approach has sufficed since, for a sufficiently short segment of a bell-shaped curve, the error will be within the required forecast precision. The chart below shows a Fisher-Pry Life Cycle market model for an innovation that has a 50 year life with an adoption growth rate of 20%.[1]



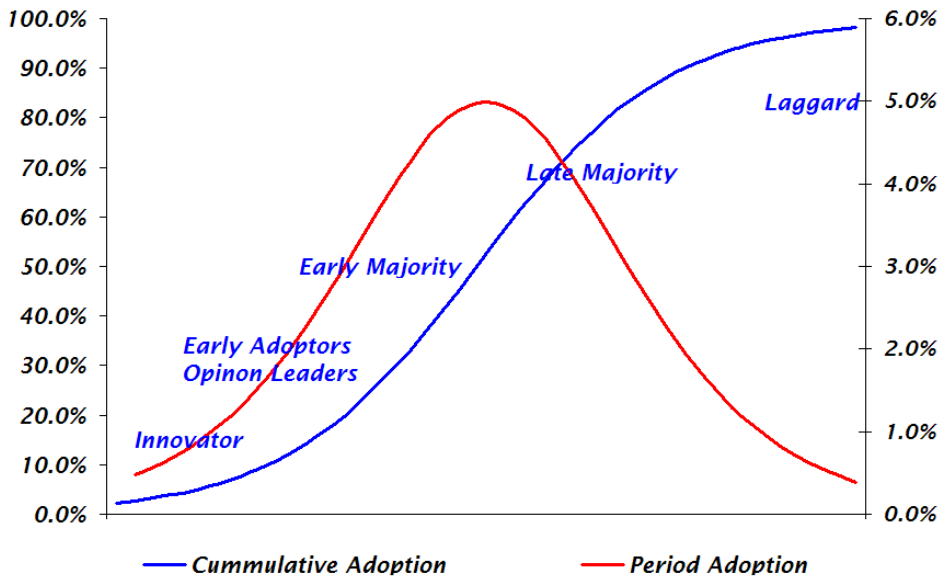
Data for shipments in the 7th through 12th years were used to compute a CAGR that was then used to forecast the 13th through the 17th years. The fit is reasonable. The error in the 13th year is only 13% usually acceptable in the 5th year of a five-year forecast. However, even in this example we can see that the error will increase if the forecast period contains an inflection point, and most significantly at the peak. There are two other inflection points. The earliest is at the point where accelerating growth changes to decelerating growth, and the final one is at the point where accelerating decline changes to decelerating decline.

However, if the life of the market is shorter, the error can become significant. In the chart below the estimated life has been shortened to 30 years.

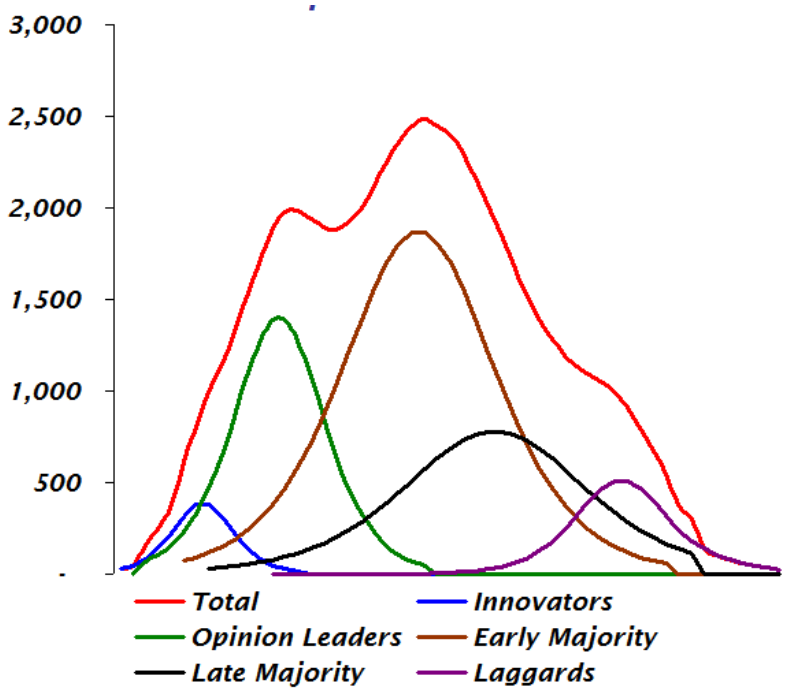


It would seem that the solution would be to apply the classic life cycle models instead of the traditional growth models. Unfortunately, the classic life cycle models have limits as well. These models, while serving adequately for the past 50 years, are not complete. The models harbor flaws that were not recognized or were ignored when life cycles were longer. As life cycles shortened, the flaws in the classic models become problematic.

In order to understand the true nature of today's markets we need to look back in time. Building on three centuries of scientific, sociological and economic research, the modern theory of how new products and services are bought by consumers was first proposed by Everett M. Rodgers in his 1962 seminal work, Diffusion of Innovations. Many are familiar with the classic graphical representation of this model with its S-shaped cumulative curve and bell-shaped periodic curve, as well as the classic division of the market into five phases.

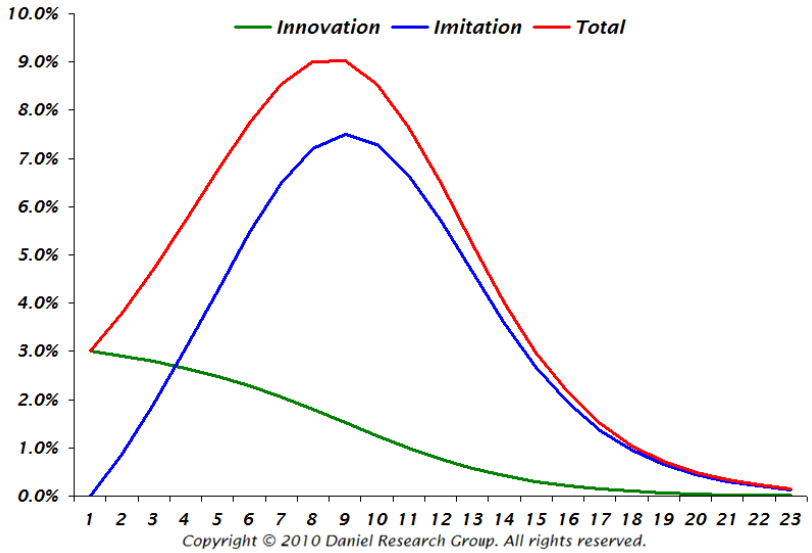


Rodgers defined diffusion as "*the process by which an innovation is communicated though channels over time among members of a social system*". From the start, most practitioners who applied this model to forecasting technology markets failed to recognize two subtle nuances of what Rodgers was saying, or not saying. First, this is only half a model. It describes how information is diffused through a social system, as well as the end result; adoption. However it does not include the adoption decision making process itself. While Rodger's correctly implied that markets are heterogeneous with regard to factors influencing adoption, his five labels have been misinterpreted to mean that there are five distinct populations that successively influence the next population. Even if this assumption of five distinct sub-populations were true it most likely would not produce the smooth curves predicted by the Roger's model. Rather the actual data would most likely have localized saddles, surges and bumps.



Geoffrey Moore in his 1991 book Crossing the Chasm, Marketing and Selling High-Tech Products to Mainstream Customer, addressed many of these issues and challenged the assumption that communication between sub-populations drives the adoption process. More to the point is questioning the assumption that one can deduce the number and nature of the heterogeneity in the market from direct observation of aggregate behavior. What if for any particular market there are 9 sub-population, or 15? And what is the adoption decision factor that differentiates each population from the other?

Four years after Rodger's book was published, Frank M. Bass published the first of his papers presenting the Bass Diffusion Model (BDM). His initial model simplified the market by segmenting it into two sub-populations; adopters who adopted because the innovation is new ("innovators"), and adopters who adopted because others did so first ("imitators").[2]



Unfortunately, in later work, the interpretation and labeling of the BDM was changed. The "innovators" became adopters who adopted due to mass media *external* influences and the "imitators" became adopters who adopted due to word-of mouth *internal* influences. For the past four decades the BDM and its extensions have been the foundation of most advanced theoretical and practical technology market forecasting work. Yet the BDM also suffers from the same flaws as the Rogers model:

1. The BDM focuses only on the communication aspect and fails to provide a mechanism that explains the adoption decision process, and

2. The BDM does not reflect complex heterogeneity in the market regarding any adoption decision factors at the individual level.

What is surprising about this is that the original Bass work pointed directly at the missing process - imitation! Imitation implies observation and that is what is missing from these models. Advocacy does influence potential adopters, both externally via mass media and internally via solicited or unsolicited word-of-mouth. However the single most important event that can influence one person, an individual consumer or business decision maker, in choosing to purchase a product or service is direct observation of others buying or using that product or service.

Furthermore, observation of adoption behavior is bounded by practical and contextual considerations. Adopters certainly do not observe the entire market. Reports and claims of penetration by vendors are simply mass media content and can be considered external advocacy. We observe those we know, or seek out, whom we have prequalified as having attributes that certify their behavior as being worthy of imitation. **Daniel Research Group** has named this observed group the Local Relevant Reference Group (LRRG).

For any innovative product or service, each individual defines both the composition of the LRRG, and the minimum number of people in the LRRG that need to be observed as having adopted the innovation, as a prerequisite for adoption by that person.

In the **Daniel Research Group** Individual Adoption Model (DIAM), the number of people in the LRRG who need to be observed adopting is symbolized by **Δ.** This quantity is unique for each individual, for that product or service, at that moment; and is a function of the collective demographic, economic, cultural and sociological factors influencing that person. The resulting model then simplifies to:

For each time period:
If number of people in the LRRG that have adopted > **Δ** then adopt
If not, then do not adopt.

For any market there is a distribution of **Δs** that represent the effective heterogeneity in the market. Since these are integer values, they represent threshold values that will account for the saddles, surges, bumps and even market failures that the older models could not predict.

Finally, how does this model explain the accelerating rate of adoption? While the size of the LRRG has increased due to significant changes in the communication process, such as social networking, the **Δs** have not. Simply put, it takes less time today than in the past for adopters to reach their **Δs** because they are observing larger LRRGs.

Applying this model using agent-based methods such as cellular automata will create market models that have better descriptive, predictive and normative properties which may be applied successfully to today's rapidly evolving technology markets. Parameters may be estimated using simple survey or panel methodologies, and eventually, analogous methods.

1. The growth/shape parameter of the Fisher-Pry model is the constant rate of change of the proportion of the market that has adopted to the proportion that has not. This is not normally a quantity that the typical technology market research analysts is familiar with. However it can be computed from, or the model calibrated to, more conventional management metrics such a CAGR, market shares or even absolute value of shipments or customers.

2. The Bass Diffusion Model is a two parameter logistic curve. As applied today, the parameters are q representing the strength of the external influence, and p representing the strength of the internal influence. The values of p and q have been empirically derived for many consumer, commercial and technical products and services and are often applied to create models using analogous approaches.

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Daniel Research Group offers consulting and market research services to clients whose products and services are technology based or enabled. The primary focus is on providing results, solutions, consulting and training to clients that have strategic and tactical decisions that require Forecast, Segmentation, Market Share, and other market modeling requirements These engagements are supported with the full range of traditional market research data gathering and analysis services, including quantitative and qualitative surveys, focus groups, demographic and firmographic data acquisition and analysis, as well as input from technology and industry experts. While our emphasis is on delivering data and actionable recommendations, we often design and develop custom models and modeling tools for client use as well as providing training in these areas.

Stephen J. Daniel - President

Mr. Daniel's three decades in the Information Technology Industry has given him a unique blend of Market and Technology experience coupled with a deep understanding of Market Research Methodology. His primary strength is in understanding the decision making context within which the results of his research will be applied. This is manifested by his ability to design and execute studies that precisely meet client objectives on schedule at reasonable costs.

After receiving his BS in Finance in 1970 from Northeastern University, Mr. Daniel earned an MBA in Quantitative Analysis from New York University in 1974. He is a member of the American Statistical Association, The Market Research Association of America, the American Marketing Association and the Qualitative Research Association of America.

DanielResearchGroup.com
49 Hill Road, Suite Four
Belmont, Massachusetts 02478
(617) 484-6225