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# INNOVATION LAG

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Paper #1001

2000

## A MEASURE OF INDUSTRY AGRESSIVENESS

*This paper provides a means to define and measure how aggressively an industry builds upon its existing technology and how that rate has changed over time. It also discusses opportunities being created as new innovations build upon existing innovations more rapidly..*

For those developing new ideas, how well they will be received by a particular industry is in part determined by how rapidly the industry builds upon its existing technologies. Note, we are not speaking of how many innovations come from the industry, but instead how fast the ideas build upon one other.

For example, within the music industry some are building upon CD technology while others are building upon DVD and internet technologies. The former are going to be much less receptive to new ideas than the latter. Today, almost all industries are building upon their existing technology faster than in the past, but some are much more aggressive than others.

### How Innovations Build Upon Prior Art

All inventions have to start somewhere. We take existing knowledge and build upon it. Look at the food industry. Man started out killing animals for food, then some turned to agriculture, it soon became possible to barter for food in open markets. General stores followed, then supermarkets, fast food, and now you can order a pizza on the internet. Each new method of obtaining food builds upon prior technologies.

The following quotations are roughly paraphrased from, “Technological Innovation and the Great Depression” by Rick Sosa.

1. Every new innovation is built upon prior art
2. Each new innovation provides a potential new stepping stone.
3. Each new innovation increases the potential for even more combinations.
4. There is considerable logic to the sequence of technological innovations.
5. The timing of a specific innovation is indeterminate.

Item 4 indicates innovations come in a logical sequence. Back to the food industry example, the idea of using the internet to order pizza would probably not have occurred to someone in the dark ages. Even if it had, they would have not been able to implement it. Automobiles, currency, pizza places, telephones, telephone systems and the internet are just a few of the things that had to be in place before you could order pizza over the internet. But as Item 5 says, we cannot exactly predict the timing of any of these innovations.

### Definition of Innovation Lag

Often, the concepts a new innovation is built upon were present for many years before the innovation was conceived. We created the term “Innovation Lag” to represent the time between when everything (technologies, materials, processes, etc) is in place for the innovation to come forward and when it is actually conceived.

## Demand

For successful new product launches, there must be a demand for the new product. In the past, that demand usually existed when the idea was conceived. On rare occasions the product itself created the demand (microwave ovens).

Back to the internet pizza example, technology was present in the early 1970's to order pizza over the internet but the demand did not exist until internet access became much easier, cheaper and more widespread. Today several firms such as Kozmo.com are offering one hour delivery of food, CDs and movies ordered over in the internet in major cities.

Inventors need to anticipate demands, create products to meet these anticipated demands based on current or soon to exist technologies and have the products ready for the market as soon as the demand exists. The great Wayne Gretzky once said, " I skate to where the puck is going to be, not where it is." So must companies in today's rapidly moving world. The real money is made in designing innovative solutions to tomorrow's problems, not today's.

We ignore the demand issue in the remainder of this discussion and assume demand existed for each innovation as soon as all the prior art was in place. We realize this is not always the case.

## Can Innovation Lag Be Measured?

The time between the filing date of a patent and the filing date of the most recent patent it cites as reference is an indicator of Innovation Lag. Obviously the prior technologies were conceived at least some period of time before patents were filed and the new technology itself was conceived before its patent was filed. However: this calculation does offer an indicator of Innovation Lag. See the Innovation Lag Illustration on the next page for a visual representation of the calculations.

You can conduct a patent search in a specific field of inventions, identify the patents in this area and calculate the Innovation Lag for each patent. Plot the results with the X-Axis representing patent filing date and the Y-Axis representing the time between the filing date and the filling date of the most recent patent it cites as a reference. The resulting data points indicate Innovation Lag for each patent. Trends observed in the data represent Innovation Lag trends for this specific field during the time period under study. Many technologies have greatly reduced their Innovation Lag in recent years.

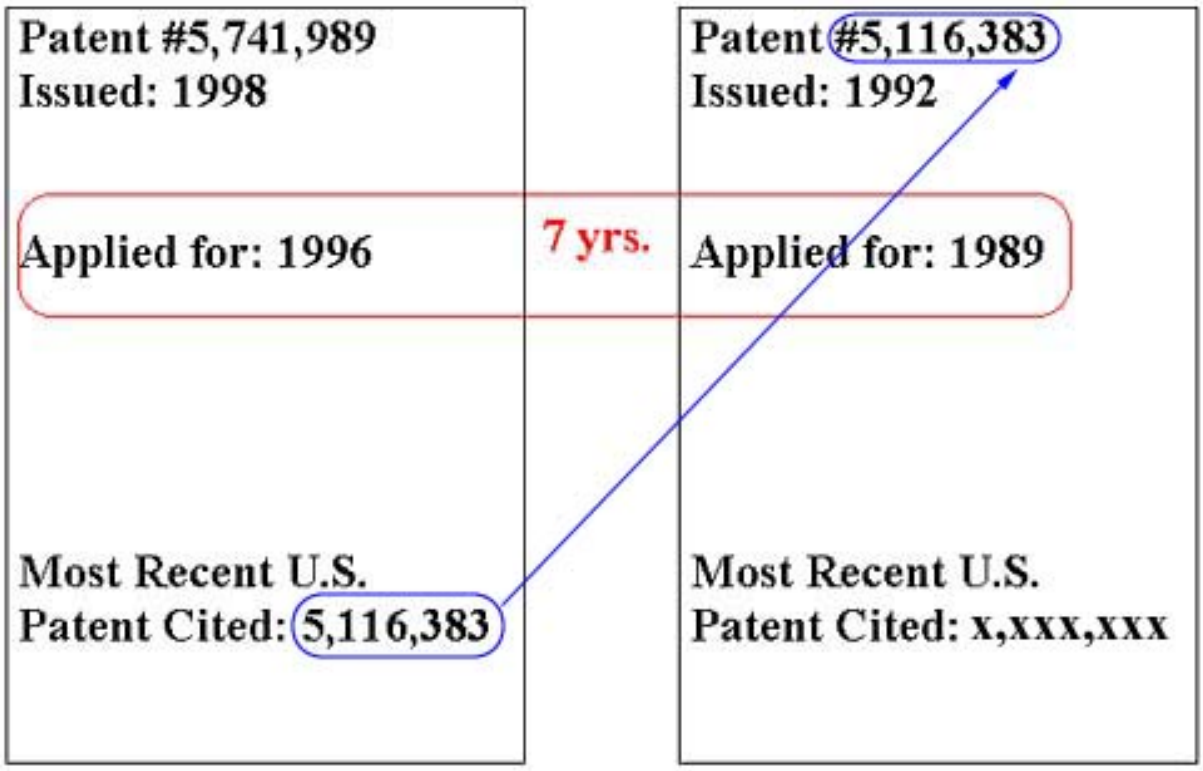
We developed the detailed procedure below..

1. Identify a specific technology.
2. Determine the time span over which you wish to examine innovation lag
3. Use normal patent searching techniques to identify patents issued during the time frame (see Step 2) associated with the technology identified (see Step 1).
4. Select one of the patents identified in Step 3.
5. Identify the filing date of the patent selected in Step 4.
6. Identify the most recent U.S. patent the patent selected in Step 4 cites as reference (the one with the largest patent number).
7. Identify the filing date of the patent in Step 6.
8. Calculate innovation lag for each patent by subtracting the filing date of the most recent patent it cites (filing date found in Step 7) from its own filing date (found in Step 5).
9. Repeat Steps 4 though 8 for each patent identified in Step 3.
10. Plot the results as a scatter plot with the X-Axis being filing date of the patent and the Y-Axis being innovation lag in years.
11. Use a curve fitting program to draw the "best fit" line through the data.

Notes:

1. The procedure ends itself to a spreadsheet.
2. The filing date of the patent cited as reference with the highest patent number may not actually represent the latest filing date among all patents cited. One of the patents issued earlier might have actually been filed for more recently. In the interest of time, we select the filing date of the most recently issued cited patent. If you wish, you can examine all the cited patents, both U.S. and foreign, and identify the one most recently filed to improve the accuracy of the calculations..

# Innovation Lag Illustration




The illustration above represents two patents. The patent on the left is one having been identified as pertaining to the specific technology being studied. It was issued in 1998 and applied for in 1996. The most recent patent it cites as reference is #5,116,383.

The patent on the right is #5,116,383. It was issued in 1992 and applied for in 1989. The difference between the application data of the patent on the left (1996) and the application date of the patent on the right (1989) is 7 years. Innovation Lag for the patent on the left is 7 years.

## An Example

We recently performed this process for contra-rotating recreational marine drive patents (outboards, stern drives and other drives with two propellers rotating in opposite directions). The spreadsheet used to make the calculations, the resulting graphs and various comments follow as Pages 5 through 11.

# Innovation Lag Study
# Contrarotating Marine Drives
### Patents Filed 1985-1999

## The Process

We used the procedure below to identify patents in this field from 1985-1999.

1. Class and subclass searching (including suggestions from the Classifications Definitions)
2. Assignee searching (three firms dominate this technology)
3. Inventor searching ( a few inventors have several patents in this field)
4. Citation searching (followed up on patents cited by each patent)
5. Word searching (developed list of keywords as the search unfolded)
6. Eliminated patents purely pertaining to ship applications (topic was recreational boat applications)

The procedure identified 81 patents. We created an Excel 2000 spreadsheet to enter the patent numbers and filing dates, calculate Innovation Lag and to make the accompanying graphs. The spread sheet has been copied to pages 6 and 7.

**Table 1 is a copy of the spreadsheet used to make the calculations. The columns are described below.**

**Column 1: Item Number**
We numbered the patents from 1 to 81 in patent number order.

**Column 2: Patent Number**
Patent number of the patent being studied.

**Column 3: X AXIS, Filing Date**
Date the patent being studied was filed with the USPTO (U.S. Patent and Trademark Office). The year portion of the date was used as the X-Axis component of the data point generated by this entry. It is the year the patent was filed.

**Column 4: Most Recent Citation Patent**
We examined the list of patents cited by the patent under study and selected the one with the largest patent number (the most recent one).

**Column 5: Most Recent Citation Filing Date**
This column is the filing date of the patent listed in Column 4 and is assumed to represent the earliest indication of all the technology being present for the invention (patent number in Column 2) to come forth.

**Column 6: Delta Days**
Number of days between the filing date of the patent under study (Column 3) and the filing date of the most recent patent it cites as reference (Column 5).

**Column 7: Y-AXIS, Delta Years**
Converts Column 6 to years. It represents the Y-Axis component of the patent under study.

**TABLE 1** **Contrarotating Propeller Patents Issued 1985 - 1999**

| Item Number | Patent Number | **X AXIS** Filing Date | Most Recent Citation Patent # | Most Recent Citation Filing Date | Delta Days | **Y AXIS** Delta Years |
|---|---|---|---|---|---|---|
| 1 | 3,938,464 | 27-Mar-74 | 3,848,561 | 15-Jan-73 | 436 | 1.2 |
| 2 | 4,132,131 | 14-Jul-77 | 3,646,834 | 28-Oct-70 | 2451 | 6.7 |
| 3 | 4,529,387 | 12-Sep-83 | 4,352,666 | 11-Aug-80 | 1127 | 3.1 |
| 4 | 4,540,369 | 22-Feb-83 | 3,467,051 | 30-Mar-67 | 5808 | 15.9 |
| 5 | 4,604,032 | 20-Jun-84 | 4,464,095 | 25-Jun-82 | 726 | 2.0 |
| 6 | 4,619,584 | 02-Feb-84 | 3,396,800 | 27-Oct-66 | 6307 | 17.3 |
| 7 | 4,642,059 | 16-Jul-84 | 3,545,585 | 04-Oct-69 | 5399 | 14.8 |
| 8 | 4,698,036 | 20-Sep-85 | 4,297,097 | 23-Feb-78 | 2766 | 7.6 |
| 9 | 4,741,670 | 12-Sep-86 | 4,642,059 | 16-Jul-84 | 788 | 2.2 |
| 10 | 4,767,269 | 26-Nov-85 | 4,623,299 | 14-Jan-85 | 316 | 0.9 |
| 11 | 4,786,264 | 04-Nov-86 | 2,470,560 | 13-Jun-39 | 17311 | 47.4 |
| 12 | 4,790,782 | 26-Feb-88 | 4,619,584 | 02-Feb-84 | 1485 | 4.1 |
| 13 | 4,792,314 | 26-Feb-88 | 4,543,854 | 05-Jan-84 | 1513 | 4.1 |
| 14 | 4,793,773 | 19-Oct-87 | 4,540,369 | 22-Feb-83 | 1700 | 4.7 |
| 15 | 4,795,382 | 29-Feb-88 | 4,529,387 | 12-Sep-83 | 1631 | 4.5 |
| 16 | 4,828,518 | 26-May-87 | 4,642,059 | 16-Jul-84 | 1044 | 2.9 |
| 17 | 4,832,570 | 01-Jul-88 | 4,637,801 | 15-Oct-84 | 1355 | 3.7 |
| 18 | 4,832,636 | 29-Feb-88 | 4,323,285 | 14-Mar-80 | 2908 | 8.0 |
| 19 | 4,840,136 | 11-Sep-87 | 4,297,097 | 23-Feb-78 | 3487 | 9.6 |
| 20 | 4,887,982 | 04-Oct-88 | 4,642,059 | 16-Jul-84 | 1541 | 4.2 |
| 21 | 4,887,983 | 09-Sep-88 | 4,273,545 | 25-Sep-79 | 3272 | 9.0 |
| 22 | 4,897,058 | 23-May-88 | 4,793,773 | 19-Oct-87 | 217 | 0.6 |
| 23 | 4,900,281 | 23-May-88 | 4,832,635 | 26-Feb-88 | 87 | 0.2 |
| 24 | 4,932,907 | 04-Oct-88 | 3,951,096 | 14-Mar-74 | 5318 | 14.6 |
| 25 | 4,963,108 | 28-Nov-89 | 2,480,806 | 25-May-40 | 18084 | 49.5 |
| 26 | 4,986,774 | 28-Mar-90 | 4,865,570 | 06-Jan-89 | 446 | 1.2 |
| 27 | 4,993,848 | 25-Jan-90 | 4,642,059 | 16-Jul-84 | 2019 | 5.5 |
| 28 | 5,000,708 | 10-Jan-90 | 4,689,027 | 16-Jan-86 | 1455 | 4.0 |
| 29 | 5,009,621 | 20-Mar-89 | 4,792,314 | 26-Feb-88 | 388 | 1.1 |
| 30 | 5,017,168 | 12-Mar-90 | 4,792,314 | 26-Feb-88 | 745 | 2.0 |
| 31 | 5,030,149 | 17-Aug-90 | 4,963,108 | 28-Nov-89 | 262 | 0.7 |
| 32 | 5,186,609 | 20-Dec-90 | 4,951,461 | 20-Mar-89 | 640 | 1.8 |
| 33 | 5,230,644 | 27-May-92 | 4,900,281 | 23-May-88 | 1465 | 4.0 |
| 34 | 5,232,386 | 10-Dec-92 | 5,017,168 | 12-Mar-90 | 1004 | 2.8 |
| 35 | 5,249,995 | 27-May-92 | 4,993,848 | 25-Jan-90 | 853 | 2.3 |
| 36 | 5,263,898 | 02-Dec-91 | 4,863,352 | 02-Nov-84 | 2586 | 7.1 |
| 37 | 5,310,371 | 26-Aug-92 | 4,486,181 | 05-Apr-82 | 3796 | 10.4 |
| 38 | 5,342,228 | 28-Jun-93 | 4,993,848 | 25-Jan-90 | 1250 | 3.4 |
| 39 | 5,344,349 | 25-Jun-93 | 4,993,848 | 25-Jan-90 | 1247 | 3.4 |
| 40 | 5,352,141 | 28-May-93 | 4,948,384 | 02-May-89 | 1487 | 4.1 |
| 41 | 5,366,398 | 28-May-93 | 5,249,995 | 27-May-92 | 366 | 1.0 |
| 42 | 5,376,031 | 25-Jun-93 | 4,993,848 | 25-Jan-90 | 1247 | 3.4 |
| 43 | 5,376,032 | 30-Jun-93 | 4,993,848 | 25-Jan-90 | 1252 | 3.4 |
| 44 | 5,376,034 | 28-Jun-93 | 4,993,848 | 25-Jan-90 | 1250 | 3.4 |
| 45 | 5,415,576 | 25-Jun-93 | 4,993,848 | 25-Jan-90 | 1247 | 3.4 |
| 46 | 5,419,724 | 22-Oct-93 | 4,786,264 | 04-Nov-86 | 2544 | 7.0 |
| 47 | 5,423,701 | 12-Sep-93 | 4,793,773 | 19-Oct-87 | 2155 | 5.9 |
| 48 | 5,425,663 | 28-Jun-93 | 5,234,362 | 21-Jan-92 | 524 | 1.4 |
| 49 | 5,441,388 | 28-Dec-93 | 4,642,059 | 16-Jul-84 | 3452 | 9.5 |
| 50 | 5,449,306 | 29-Nov-93 | 5,006,084 | 14-Oct-88 | 1872 | 5.1 |
| 51 | 5,462,463 | 21-Nov-94 | 5,249,995 | 27-May-92 | 908 | 2.5 |
| 52 | 5,494,466 | 31-Jan-95 | 3,520,205 | 16-Oct-68 | 9603 | 26.3 |
| 53 | 5,514,014 | 29-Jan-94 | 5,366,398 | 28-May-93 | 246 | 0.7 |
| 54 | 5,520,559 | 12-Apr-95 | 5,006,084 | 14-Oct-88 | 2371 | 6.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 55 | 5,529,520 | 04-Oct-94 | 4,911,665 | 04-Aug-88 | 2252 | 6.2 |
| 56 | 5,556,312 | 31-May-95 | 5,336,398 | 28-May-93 | 733 | 2.0 |
| 57 | 5,556,313 | 31-May-95 | 5,366,398 | 28-May-93 | 733 | 2.0 |
| 58 | 5,558,498 | 31-May-95 | 5,449,306 | 29-Nov-93 | 548 | 1.5 |
| 59 | 5,575,698 | 29-Nov-94 | 5,366,398 | 28-May-93 | 550 | 1.5 |
| 60 | 5,597,334 | 05-Jun-95 | 5,366,398 | 28-May-93 | 738 | 2.0 |
| 61 | 5,599,215 | 22-Dec-93 | 5,078,628 | 23-Jun-89 | 1643 | 4.5 |
| 62 | 5,601,464 | 30-Nov-94 | 5,366,398 | 28-May-93 | 551 | 1.5 |
| 63 | 5,697,821 | 31-May-95 | 5,366,398 | 28-May-93 | 733 | 2.0 |
| 64 | 5,755,605 | 27-Jan-95 | 5,134,949 | 07-Aug-90 | 1634 | 4.5 |
| 65 | 5,759,073 | 04-Sep-96 | 5,529,520 | 04-Oct-94 | 701 | 1.9 |
| 66 | 5,766,047 | 25-Sep-96 | 5,529,520 | 04-Oct-94 | 722 | 2.0 |
| 67 | 5,766,048 | 05-Jun-96 | 5,529,520 | 04-Oct-94 | 610 | 1.7 |
| 68 | 5,788,546 | 12-Jul-96 | 5,575,698 | 29-Nov-94 | 591 | 1.6 |
| 69 | 5,791,950 | 05-Dec-96 | 5,529,520 | 04-Oct-94 | 793 | 2.2 |
| 70 | 5,795,200 | 22-Sep-95 | 4,964,844 | 02-Nov-89 | 2150 | 5.9 |
| 71 | 5,800,223 | 22-May-96 | 5,423,701 | 12-Sep-93 | 983 | 2.7 |
| 72 | 5,807,151 | 18-Oct-96 | 5,423,701 | 12-Sep-93 | 1132 | 3.1 |
| 73 | 5,820,425 | 04-Sep-96 | 5,575,698 | 29-Nov-94 | 645 | 1.8 |
| 74 | 5,839,928 | 12-Nov-96 | 5,520,559 | 12-Apr-95 | 580 | 1.6 |
| 75 | 5,888,108 | 31-Mar-97 | 5,310,371 | 26-Aug-92 | 1678 | 4.6 |
| 76 | 5,890,938 | 02-Oct-97 | 5,601,464 | 30-Nov-94 | 1037 | 2.8 |
| 77 | 5,902,160 | 09-Feb-98 | 5,529,520 | 04-Oct-94 | 1224 | 3.4 |
| 78 | 5,921,826 | 24-Nov-95 | 4,795,382 | 29-Feb-88 | 2825 | 7.7 |
| 79 | 5,921,828 | 13-May-97 | 5,597,334 | 05-Jun-95 | 708 | 1.9 |
| 80 | 5,954,479 | 29-Nov-97 | 5,441,388 | 28-Dec-93 | 1432 | 3.9 |
| 81 | 5,961,358 | 16-Mar-98 | 5,435,763 | 01-Aug-94 | 1323 | 3.6 |

## Discussion of Results

We plotted the results as three charts. Chart 1 is the basic data, Chart 2 is the basic data overlaid with a best fit curve and chart 3 is an attempt to show how history could be changed if the relatively long Innovation Lag (over 45 years) for two innovations was more in line with the other inventions.

**Chart 1** plots the date a patent was filed (X-Axis) against the date the most recent patent it cites as reference was filed (Y-Axis). The larger the Y-component the longer the innovation lag for that particular invention. The data points are scattered, but you can observe a general trend of decreasing innovation lags throughout the period under study. There were a two inventions in the mid 1980s with innovation lags of over 45 years. These inventions gave up 45 years of potential sales if a demand existed for them.

**Chart 2** Uses a red line to illustrate the 2nd degree polynomial best fit of the data. Innovation lag decreased from over 8 years in 1982 to approximately 1 year in 1998.

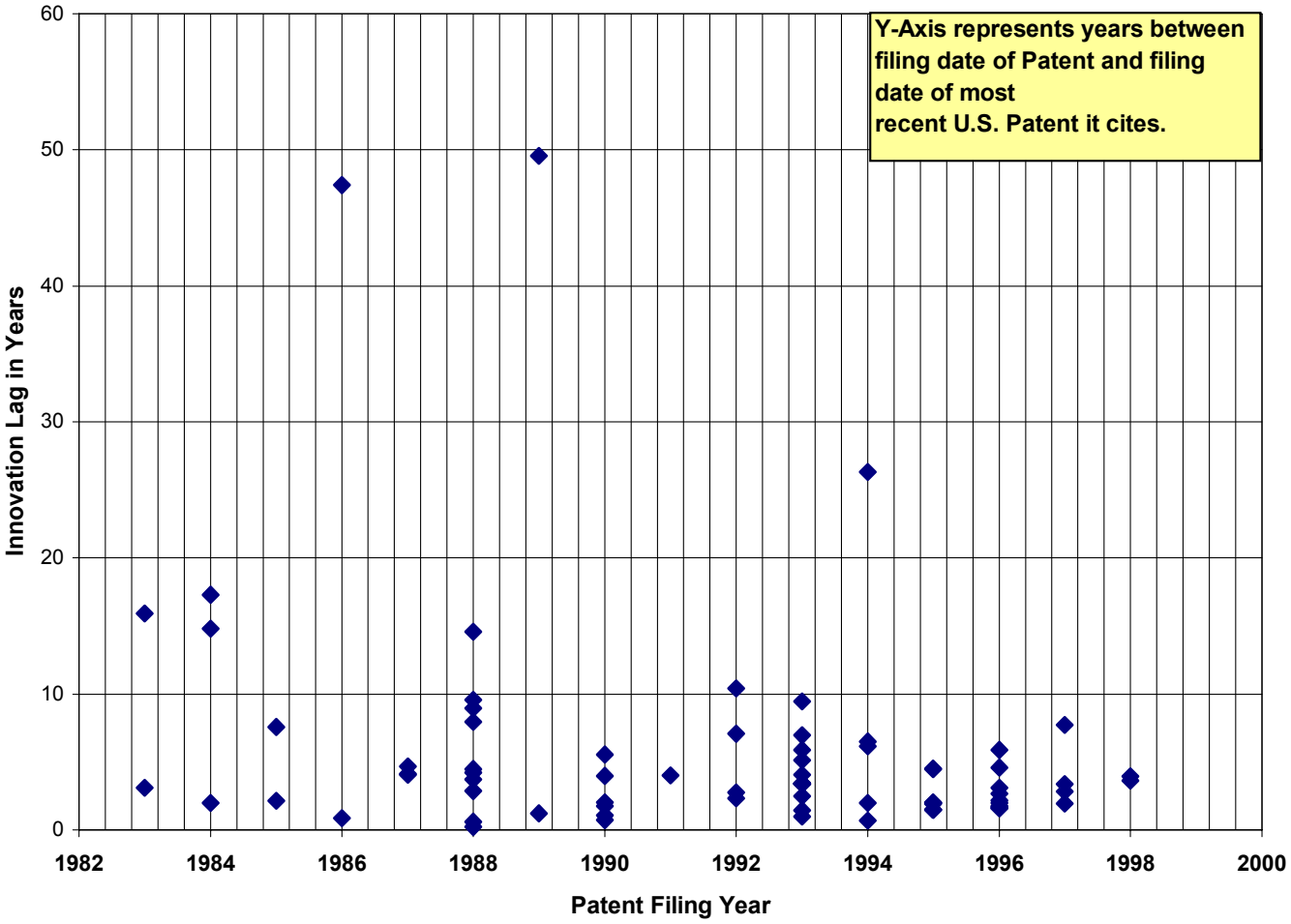
Note—we reduced the vertical scale of the chart. The a few of the larger year value data points are not shown in this graph, but their data is included in the best fit curve.

**Chart 3** uses two stars to indicate two inventions in the mid 1980s citing patents filed in the 1940s as their most recent references. Theoretically, these two inventions could have been introduced in the late 1940s as depicted on the graph. If they had been introduced at that time, other inventions could have built upon them for almost 40 years before they were able to due to their large Innovation Lag..

### Discussion of the data

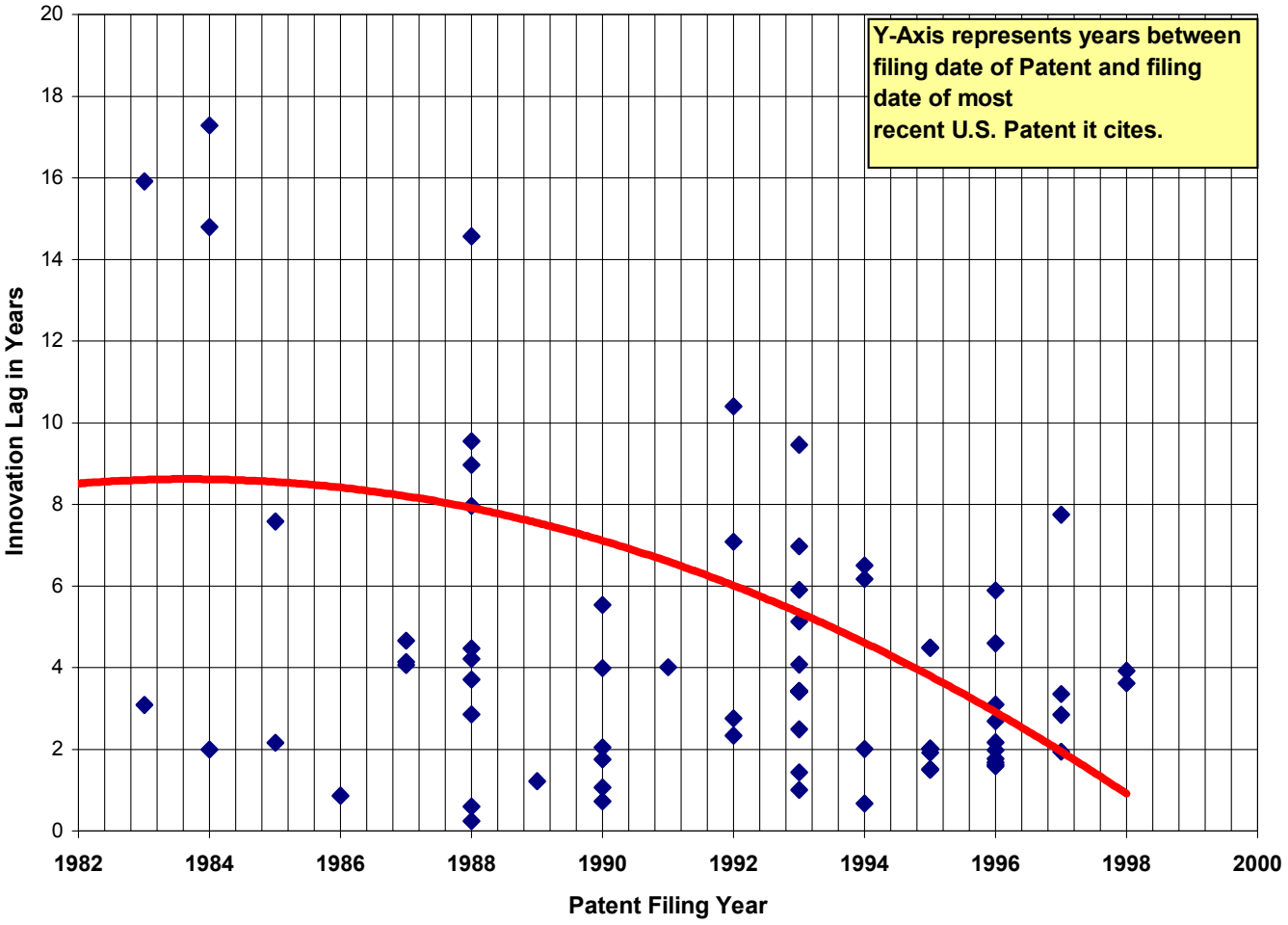
Contrarotating marine drive technology, innovations based on recent technologies are coming forth much more rapidly than in the past. Innovation Lag appears to be continuously decreasing. The approximate one year lag in 1998 is about in line with the time it takes most patents to go through the patent system. Meaning the new patents were being filed just as the old ones were being issued. In some cases a patent might not be issued at the time a patent citing it is filed. These citations are added later by the examiner or a representative of the inventor while the patent is still being reviewed by the USPTO prior to being issued.

## Innovation Lag Chart 1

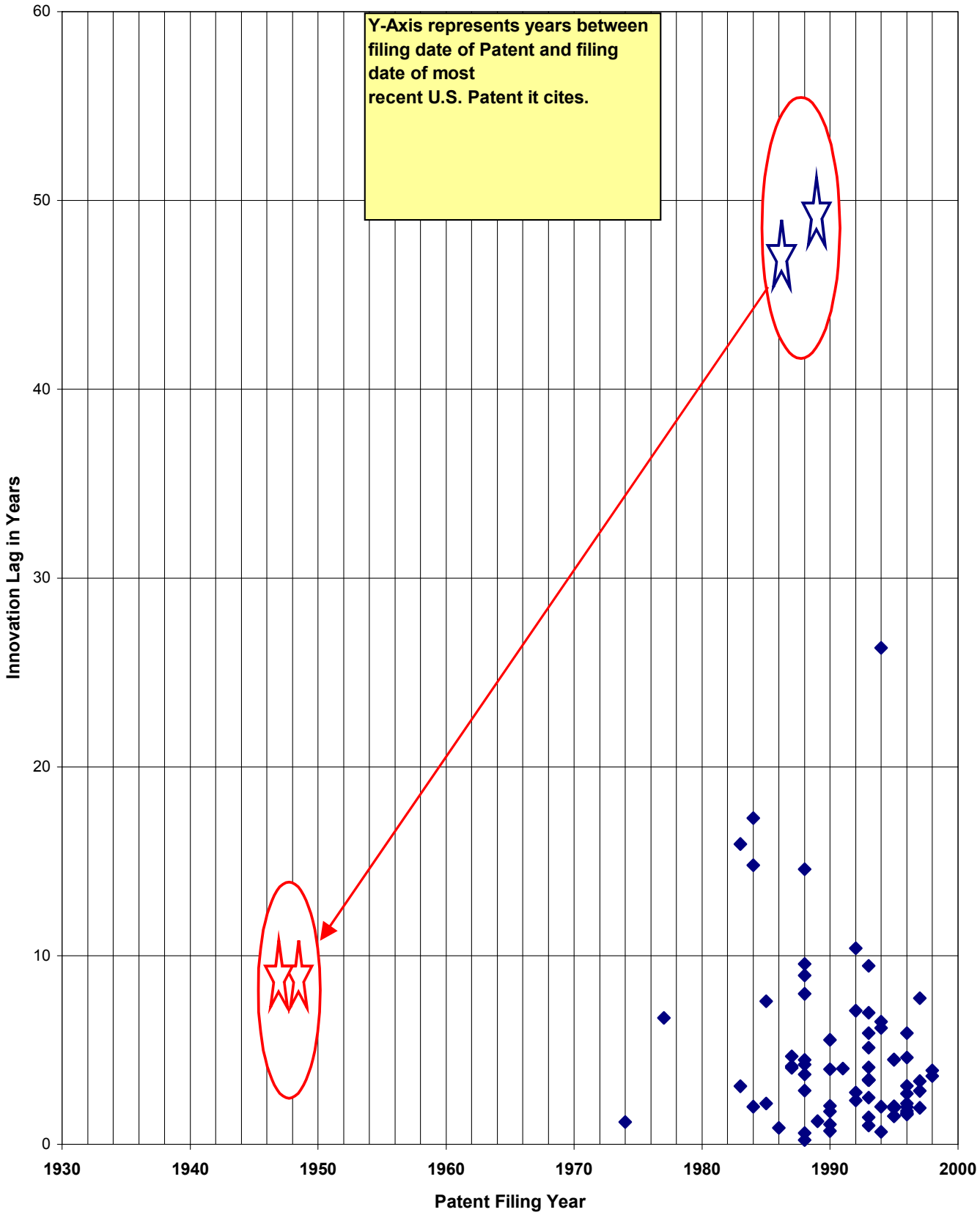


Red line is polynomial best fit

## Innovation Lag Chart 2



## Innovation Lag Chart 3



## Parting Thoughts

Innovation Lag is rapidly decreasing in many technologies, creating numerous opportunities. By continuing to reduce Innovation Lag we improve our products, companies and our local and national economies. The clock is running !

## REFERENCE

Below are the exact quotations from “Technological Innovation and the Great Depression” by Rick Szostak. paraphrased at the front of the article.

“Each innovation is a synthesis of pre-existing ideas. Invention is a new combination of the prior art. Technology develops through physical artifacts, and thus there is considerable logic to the order in which innovations occur.”

“With each innovation the potential for new combinations increases.”

“… while the order of stages of technological innovation is logical, the timing of any innovation is indeterminate.

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Polson Enterprises Research Services, webmasters of "How to Learn About and Industry or a Specific Company" (www.virtualpet.com/industry/howto/search.htm) and dozens of other information based web sites, provides extensive business research services in addition to generating product and service ideas. Contact us about your specific research needs.

We are active in:

- New Product Development
- Market Research
- Competitive Intelligence
- Legal & Intellectual Property Research
- Technology Research
- Strategic Planning Support
- Technological Forecasting
- Economic Impact Studies
- Leisure Activity Research
- Brainstorming
- Promoting New Technologies

## Our Researcher and His Tools

Gary Polson, has extensive research experience at a fortune 500 firm. He has masters degrees in both Mechanical Engineering and Physical Education from Oklahoma State University, holds two patents, is a licensed professional engineer and a Certified Strength and Conditioning Specialist. He is strongly involved in the boat building industry and webmasters the industry's premier web site, RBBI (www.rbbi.com).

Besides our own extensive research library and many online research tools and databases, we have local access to 2 major university libraries (Oklahoma State University and the University of Oklahoma), one large metropolitan library (Tulsa City County Library), a federal depository (Oklahoma State University), a Patent Library (Oklahoma State Patent and Trademark Library), one of the largest law libraries in the southwest (University of Oklahoma Law Library) and several local special collections.

We have assisted new product developments in many areas. Some are listed below.

Boating Industry
Boat Building
Marine Drives
Propellers
Propeller Guards
Fish finders
Construction Equipment
ATV's
Motorcycles
Snowmobiles
Personal Watercraft
Aviation Industry
Engines
Medical Devices
Digital Photography Industry
Augmented Reality Products
Sensors
Corrosion
Hydraulic Systems
RC Airplanes
Novelties
Virtual Pets
Beverage Industry
Restaurant Industry
ERP Applications
Internet Tools
Pet Products
Equine Products
Rodeo Accessories
Wildlife Management
Law Enforcement Devices
Correctional (Prison) Equipment
Water Rescue Devices
Tornado Shelters
Highway Construction
Products for the Disabled
Sports Equipment
Toy Industry
Funeral Industry