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INNOVATION MANAGEMENT: THE PAST, PRESENT AND FUTURE OF THE MARKET

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Abstract:

The paper presents aspects of innovation management, important issues based on literature and studies by Boston Consulting Group (USA). The case study lays on the survey made by BCG on 1500 subjects all over the world from all the industry sectors. The paper studies the importance of innovation management and makes predictions for research and development expenditure for Top4, Apple, Google, Tesla Motors and Microsoft, without taking into account rank number 5, Samsung, because the official income statement was in Korean Won.

Key words: *innovation management, Boston Consulting Group list, innovation, prediction, Research and Development*

1. Introduction

Mobile World Congress, 21st February 2016, 6.00 PM GMT - Samsung presents Galaxy S7, S7 Edge and Gear 360 and announces the partnership with Facebook. – A big event on stage, innovation backstage. Samsung is not the only company that relies on innovation to keep customers. Apple, it's business rival, makes changes and prepares iPhone7 and iPhone7S to launch in September. iPhones are the most popular smartphones on the market. The fight is tight, innovation makes the difference.

The economics literature mentions Schumpeter's "The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle", the first publication that defines the innovation concept. But Schumpeter's books rest almost 30 years, till end of 70ties, beginning of 80ties, last century, when they get actual. He wrote that innovations are "the carrying out of new combinations". Everett Rogers, another researcher known for the diffusion of innovation theory, influenced the

North-American companies, and defined 1983 innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoptions". Nevertheless, "innovation represents an activity from which a new or significantly improved product (good or service) launched on the market results, or represents the introduction of a new or significantly improved process in its own unit. Innovation relies on the results of a new technology, of technological development, of new combinations of existent technologies or on using other knowledge obtained."

Our opinion is that innovative management is based on three fundamental elements: the idea, the reaction speed and the technology to implement the idea.

2. The Most Innovative Companies

The mission and target of innovation management is the systematic sustain of the entire innovation process from generating new ideas to implement them into new products.

The Boston Consulting Group generates a list of the most innovative companies, list "based on the 2005-2010 BCG/Business Week Senior Executive Innovation Survey and the 2012 – 2015 BCG Global Innovators Survey of senior executives and represents a wide variety of industries in every region". The list contains also data for all companies beginning from 2005 for revenues, profits, total shareholder returns and research and development expenditure. It is to be mentioned that the data are change percentages.

One of the questions in the survey is: "Where does innovation/product development rank among your company's top strategic priorities?". 79% of the respondents put innovation the top or among the top three priorities, see figure 1. "At the same time, science and technology continue to be seen as increasingly important underpinnings of innovation, enabling four attributes that many executives identify as critical: an emphasis on speed, well-run (and very often lean) R&D processes, the use of technological platforms, and the systematic exploration of adjacent markets."

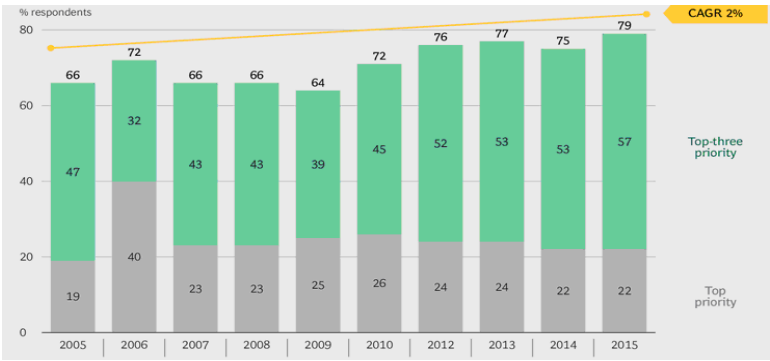
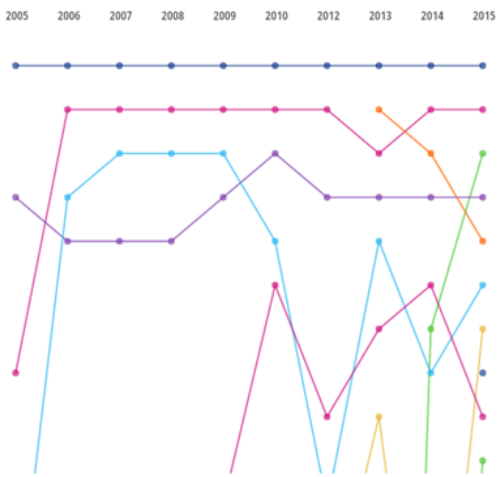


Figure 1: Innovation Remains at the Top of Most Companies' Agendas

Source: BCG Global Innovation Survey, 2005-2015

Fast-tech companies, tech-savvy automakers, and a company that exemplifies scientific expertise combined with lean R&D in the pharmaceutical industry round out the top ten. First place belongs to Apple since 2005. Although, Steve Jobs, and the Apple team first launched an iPhone 2007 and since then every single year, the company tries to improve the product by innovation to compete with the business rivals. Apple leads the top of the most innovative companies in the world, followed by Google, Tesla Motors and Microsoft. Samsung, the business rival ranks five. Table 1 presents the 10 most innovative companies and the graphic that result from the survey done by Boston Consulting Group. We remind that the numbers are change percentages from previous to next year.

Table 1 & Fig 2: The Most Innovative Companies



2015 rank	Company	2013 to 2014 change (%) Revenue	EBIT	TSR	R&D spending
1	Apple	7.0	7.2	40.4	35.0
2	Google	10.3	19.8	–6.1	24.3
3	Tesla Motors	58.8	NA	47.9	100.4
4	Microsoft	11.0	0.0	27.5	5.8
5	Samsung	–9.8	–32.0	–1.8	4.3
6	Toyota	16.4	73.5	21.1	0.4
7	BMW	5.7	11.6	8.3	–0.2
8	Gilead	122.2	235.0	104.5	18.1
9	Amazon	19.5	–81.2	–22.2	41.3
10	Daimler	10.1	22.7	13.3	9.8

Source: BCG

To get to billion dollar numbers, data from marketwatch.com compared with those from statista.com were used to come up with the following table. In our opinion revenue and research and development expenditure are important (R&D spending are percentage from revenue).

Table 2: Revenue and R&D expenditure evolution since 2011 (bill.$)

		2011	2012	2013	2014	2015
Apple	**Revenue**	108.60	157.04	170.87	183.24	231.28
	R&D spending	2.43	3.38	4.48	6.04	8.07
Google	**Revenue**	37.86	49.96	59.73	65.83	73.59
	R&D spending	5.16	6.59	7.91	9.83	12.28
Tesla Motors	**Revenue**	0.2042	0.4132	2.01	3.20	4.05
	R&D spending	0.2089	0.2739	0.2319	0.4647	0.7765

Microsoft	**Revenue**	69.94	73.75	77.65	86.73	92.97
	R&D spending	9.04	9.81	10.41	11.38	12.05
Samsung	**Revenue**	165 T	201.1 T	228.69 T	206.21 T	200.65 T
	R&D spending	9.27 T	10.7 T	13.3 T	13.27 T	12.43 T

Source: www.marketwatch.com, www.statista.com

It is to be mentioned that all the numbers are in billion dollars (short billion), except Samsung were all the numbers are in KRW millions. Revenue and research and development spending for Google are actually the numbers from Alphabet Inc., because Google is part of this company. The table shows only the period between 2011 and 2015 because Tesla Motors has very low numbers and it couldn't be put in a small dimension graphic, together with the others.

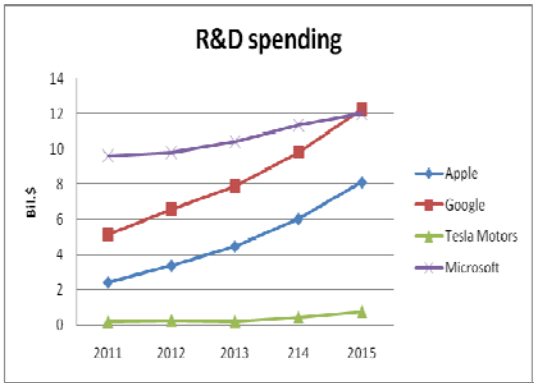
The question is: why is Apple on the first place if it doesn't have highest revenues and research spending? The Boston Consulting Group took into consideration not only these numbers, important among other criteria were the patents registered by each company and a rank each subject of the survey had to establish for its industry. For example, Microsoft spent 2015 12.05 billion dollars (Tab. 3), Apple only 8.12 billion dollars for research and development, but Apple registered the most patents. Figure 3 presents the evolution of R&D expenditures for the last five years.

Table 3 Revenue evolution for Top 4 (bill.$)

	2011	**2012**	**2013**	**2014**	**2015**
Apple	2.43	3.38	4.48	6.04	8.12
Google	5.16	6.59	7.91	9.83	12.28
Tesla Motors	0.2089	0.2739	0.2319	0.4647	0.7765
Microsoft	9.6	9.81	10.41	11.38	12.05

Source: www.marketwatch.com, www.statista.com

Fig. 3 R&D spending evolution graphic for Top 4



3. Revenue Prediction for Top 4

Using the information about the R&D spending gathered from marketwatch.com and a software named CurveExpert 1.4, we can make predictions for the next years. To exemplify, we took Apple, Google, Tesla Motors and Microsoft, for the next five years. Year 2011 is noted with 1, 2012 with 2 and so on until 2020 noted with 10.

We have run the program with the existing numbers and this showed a series of graphic approximations together with models of mathematic regressions.

Fig. 3 Richard Model – mathematical model

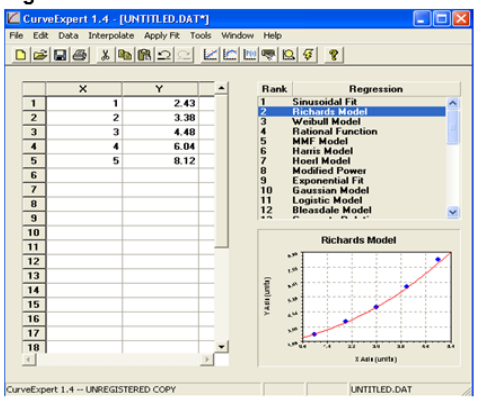
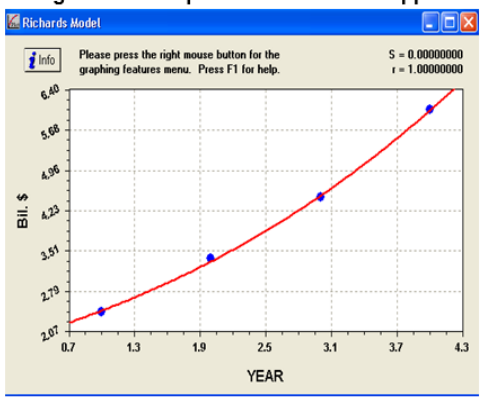


Fig. 4 Revenue prediction curve for Apple



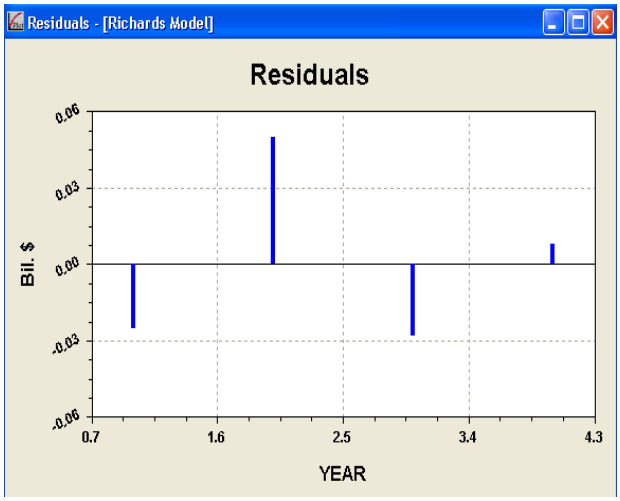
We chose the Richards Model because, the standard error, noted with S, is zero and correlation coefficient, noted with r, is 1, so the mathematical model is reliable.

This can be also seen in the dispersion of the residuals to zero:

Fig. 5 Residuals for Richard Model

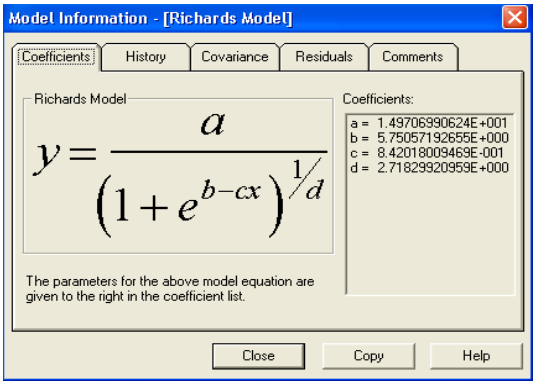
Residual Table:

1	-0.02381572635
2	0.0470468934
3	-0.02649572245
4	0.007611908239



The mathematical model proposed for this method is:

Fig. 6 Mathematical formula for Richards Model



Using this formula, we can calculate Research and development expenditure predictions for any year.

"We're going to patent it all", said Steve Jobs to his innovation engineers, when it came 2006 about the iPhone. Apple has a big innovation department, this is for sure. Not only the "iEconomics" series of articles in the New York Times, that got a Pulitzer, mentions that, Apple itself, but also an article in "Journal of Engineering and Technology Management" in 1991. One is clear, Apple spends for example, 2011, 2.43 bill.$ for research and development, much more for patenting and around 20 bill.$ for patent litigation.

Another big company that spends more for patent protection than for research and development is Google. Here we tried to predict the R&D expenditure for Google for the next five years and applied the same procedure like Apple.

Fig. 7 Harris Model – mathematical model

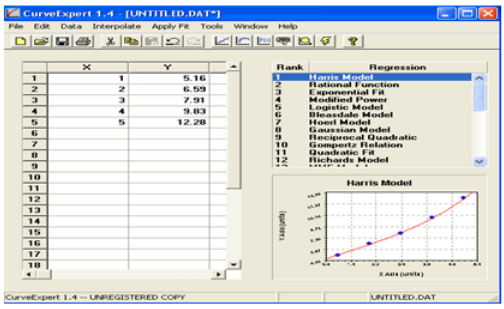
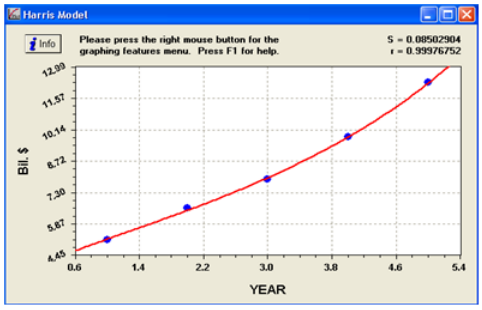
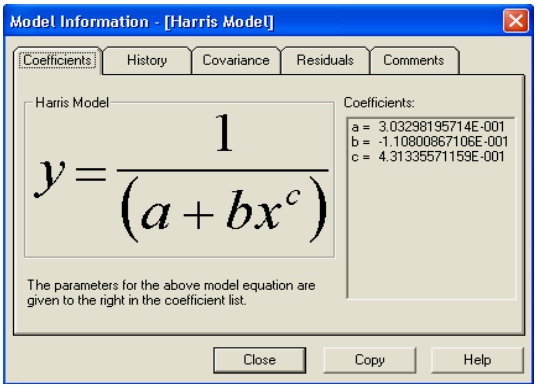


Fig. 8 R&D prediction curve for Google



We choose the "Harris Model" with S – the smallest value and r – the highest value from all displayed mathematical models.

Fig. 9 Mathematical formula for Harris Model



The trend is ascending like the other companies. For Tesla Motors we will proceed alike:. We choose the "Hoerl Model" because the residuals dispersion is uniform.

Fig. 9 Hoerl Model – mathematical model

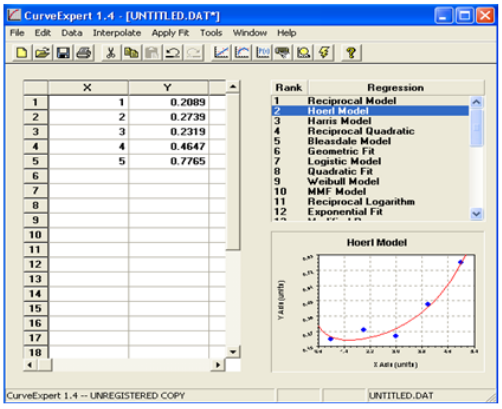


Fig. 10 R&D prediction curve for Tesla Motors

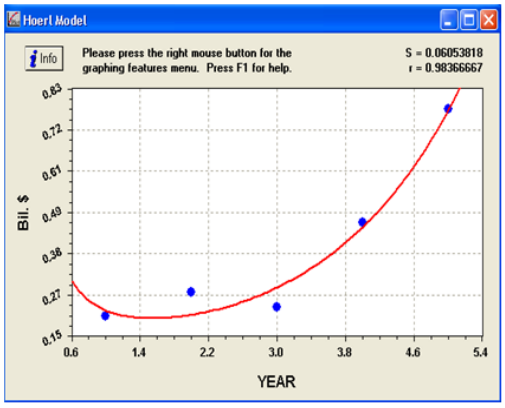
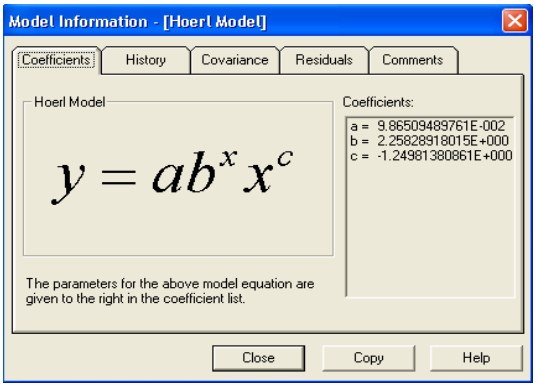


Fig. 11 Mathematical formula for Hoerl Model



Alike we will proceed with Microsoft:

Fig. 12 Weibull Model - mathematical model

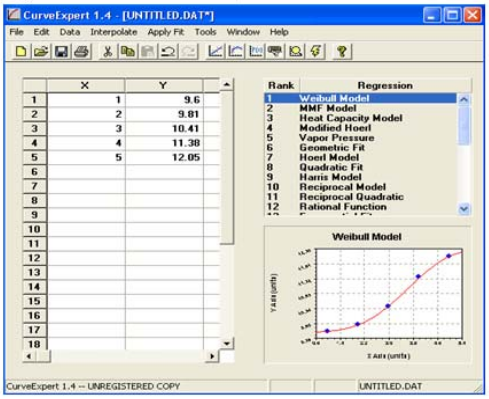
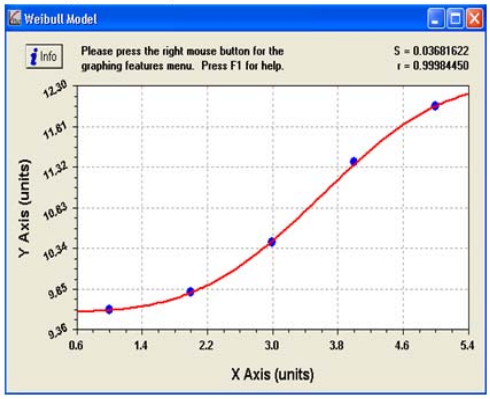
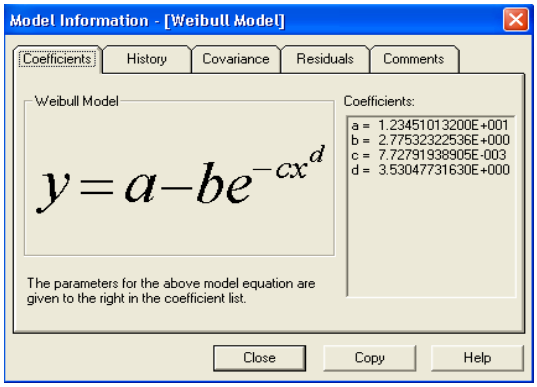


Fig. 13 R&D prediction curve for Microsoft



We will choose the "Weibull Model" with the minimal value S=0.03681622, r=0.99984450 and uniform dispersed residuals.

Fig. 14 Mathematical formula for Weibull Model



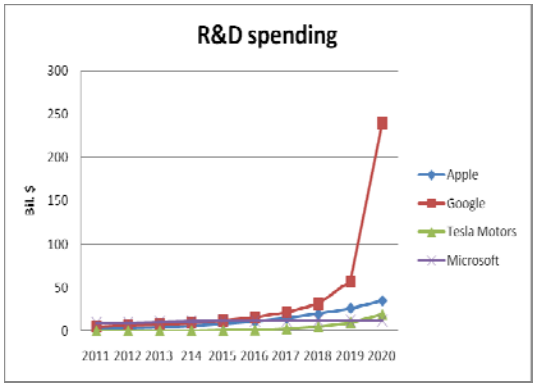
Appling for each company the four proper formulas we get the level of research and development expenditure between 2016÷2020.

It is to be mentioned that the mathematical model doesn't take into consideration unexpected factors from economics, politics etc. Can be applied only in an uniform environment.

Table 4: Top4 R&D spending prediction in bill. $

	2016	2017	2018	2019	2020
Apple	10.85903	14.52138	19.40435	25.9144	34.5929
Google	15.79496	21.36204	31.64008	57.32052	240.65798
Tesla Motors	1.39391	2.59623	4.96185	9.67145	19.14622
Microsoft	12.30813	12.34347	12.34508	12.3451	12.34513

Fig. 15 R&D spending graph for the next 5 years



"Apple has always stood for innovation," the company wrote in a statement in response to questions from The New York Times. "To protect our inventions, we have patented many of the new technologies in these groundbreaking and category-defining products. In the rare cases when we take legal action over a patent dispute, it's only as a last resort."

4. Conclusions

Innovation is not research and development. Research and development can have as a result innovation but not necessary. To be innovative, a company needs a department that innovates. It is important to choose between one or another capability to be innovative in. Protection of innovation by patenting needs a big sum of money.

The rank made by BCG bases only on its survey and corresponds partially with other lists. The trend in spending money for research and development is ascending and in the next five years, companies at the top may change their places. New entries are not excepted, see Gilead, number 8 in the rank.

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