Mobile Phone Companies Increasing Market Share through Innovations, R&D Spending and Patents

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Abstract

This study aims to analyze the market share of four leading mobile phone companies in the context of their spending on R&D and the number of filed patents. The study aims to identify whether the companies that invest the most in R&D and file more patents have a competitive edge and increased market share compared to others. The adoption and advancement of technologies throughout the documented history of humankind have revealed how employing specific devices has cultivated the power for people and society to communicate. Moreover, innovations in travelling have increased prospects for real-time communication, and innovations in virtual real-time communication like mobile phones and the internet have become a part of everyday life. Following innovations, many companies emerged from nowhere with unique mobile phone devices and continued the business. But, few of them were wiped out from the market because their mobile phone offering was inferior to other competitors. This paper explores the innovation journey of mobile phone companies. In addition, it focuses on four leading brand names and corresponding success failures as well as the role of R&D expense and patents regarding innovations. Usually, innovation is considered as the engine of economic growth that serves customers better products and services and stays relevant in the market. Measuring innovation is not easy, but focusing on R&D and the quantifiable patent indicates that individual companies consistently serve customers with newer and better products.

Keywords: Innovations, R&D Spending, Patents, Market Share, Mobile Phone

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I. Introduction

The mobile phone marketplace is incredibly competitive, and the market has numerous mobile phone brands with lucrative offerings. According to Gadgets 360, there are 170 mobile phone manufacturing companies (Gadget360, 2022). The Droid.com website lists 237 mobile manufacturing companies and suggests 7576 different models from different companies (Droidchart.com, 2022). According to the GSMArena website, there are 117 Mobile companies and 11197 models globally (Gsmarena, 2021). Not necessarily all mobile companies, and the mobile phone model still exists. At the same time, many companies are still present and producing various mobile phone models. The mobile phone market is perhaps the most volatile, challenging, and constantly in the race of competition among brands. Nevertheless, mobile companies deal with continuous technological change, and product innovation is astonishing. Since 1973, mobile phones have emerged from a luxury to a mass consumer market with many value-added services.

Figure 1 has a list of a few mobile phones since 1973 that indicates consistent innovations by various mobile companies (Križanović, 2020; Mobikyo, 2014; Uswitch, 2021).

YEAR	Company Name	Phone Model Features
1973	Motorola	DynaTAC 8000X – It was almost a 2.4 lb phone with just 30 min Talktime. This device needed 10 hours to charge fully
1985	Siemens	Mobiltelefon C1 – This phone came in the form of a suitcase and weighed almost 1.5 lb
1987	Nokia	Mobira Cityman 900 – In the '80s, this phone was the most stylish and lightweight phone considered expensive.
1988	Samsung	SH-100 – It is a reasonably lightweight cellphone that was designed and manufactured in Korea.
1989	Motorola	MicroTAC – Motorola first brought a new "flip" design, where the "mouthpiece" folded over the keypad.
1992	Nokia	Nokia 1011 – The first 2G phone which was mass-produced
1994	IBM	IBM's Simon – It was the first touch screen phone designed by IBM and manufactured by Mitsubishi Electric
1996	Motorola	StarTAC is considered the first clamshell (flip) mobile phone with a vibration feature.
1996	Nokia	Nokia Communicator 9000 – is considered the first QWERTY cellphone with many business features such as web browsing, e-mail, fax, etc.
1997	Hagenuk	Hagenuk GlobalHandy – This was the 1st mobile phone without an antenna
1998	Siemens	Siemens S10 – This was the first mobile phone with a color screen
1999	Motorola	Motorola Timeport – is the first tri-band GSM phone considered the first phone that worked in Europe, the U.K., and the USA.
1999	Nokia	Nokia 7110 - 1st launched WAP browser phone to browse the internet
1999	Kyocera	Kyocera VP-210 – is the world's first mobile color videophone
2000	Sharp Corporation	Sharp J-SH04 – is made by Sharp Corporation and released by J-Phone (SoftBank Mobile). The company claims to launch the first camera phone that contradicts Kyocera.
2000	Samsung	Samsung SPH-M100 (UpRoar) – The 1st cell phone with MP3 music capabilities
2001	Nokia	Nokia 5210 - designed for use in harsh conditions and is dust, shock, and water-resistant.
2001	Benefon	Benefon Esc! - The first phone to launch GPS capabilities
2001	Nokia	Nokia 8310 – is the first phone with I.R., a radio, and calendar features
2001	Ericsson	Ericsson T39 – The first phone with a Bluetooth feature
2001	Nokia	Nokia 7650 – The first Symbian O.S. phone
2002	Sanyo	Sanyo SCP-5300 is a phone with a dual-color display and a camera with a flash. It allowed seeing the picture on the phone screen without plugging into the computer
2004	Nokia	Nokia 7610 - The first phone with a 1-megapixel camera (1152x864 pixels) and was targeted at "fashion-conscious" individuals
2004	Nokia	Nokia 6630 – The first phone with a global roaming feature
2005	Casio	Casio G'zOne – The first phone that could survive submerged in water up to one meters
2007	Apple	iPhone – The first fully touch-based interface without a keyboard.
2008	HTC Dream	HTC Dream - the first mobile using the Linux-based Android operating system and other google services
2009	Samsung	Samsung GT-i7500 – It is the first Samsung Galaxy phone
2009	Motorola Droid	Motorola Droid – The first phone with Google Maps Navigator
2010	Samsung	Samsung Galaxy S – The first Galaxy S series phone and thinnest smartphone with the fastest graphical processing of its time
2010	Sony Ericsson	Xperia Play – Launched a game-console-enabled phone to provide the gaming experience.
2011	Motorola	Motorola Atrix - The first phone with a fingerprint sensor.
2011	Apple	iPhone 4S - The first personal digital voice assistant through Siri features
2012	Samsung	Galaxy S3 – A phone with a personal voice assistant and eye-tracking feature
2012	Nokia	Lumia 920 – is a high-sensitivity capacitive touchscreen, and the screen works with gloves and fingernails. It had wireless inductive charging features
2013	Apple	iPhone 5S – The first phone with fingerprint sensors
2015	Samsung	Galaxy S5 - the first smartphone with a feature to monitor a heart rate
2015	Samsung	Galaxy S6 Edge - the first smartphone with a curved screen edge
2016	Sony	Sony Xperia X.Z. – The first phone with an HDR display
2016	Apple	iPhone 7 Plus – A phone with dual lenses, without a headphone jack, and a waterproof iPhone
2017	L.G.	L.G. G6 - A phone with Dolby Visions
2017	Apple	iPhone 8 - The first wireless charging iPhone
2018	Huawei	Huawei p20 pro – A phone with three lenses, i.e., 40 M.P. lens, 20 M.P. lens, and 8 M.P. lens.
2020	Samsung	Galaxy Flip Z 5G - the phone folds horizontally and uses a hybrid glass coating branded as "Infinity Flex Displays."

Figure 1. Mobile Phone Brands from 1973 until 2020

Source: (Križanović, 2020; Mobikyo, 2014; Uswitch, 2021)

II. R&D, Patents and Innovations

In general, an innovation endeavor is a complex process and is commonly described as the generation, implementation, and acceptance of new ideas, products, services, or techniques (Ferreira et. al., 2020). Innovation capability can be stated as the expertise and ability to enrich present products and technologies as well as creating something new by translating expertise into products and processes (Romijn & Albaladejo, 2002). Innovation capability signifies a company's capability to build innovative tools & products to accomplish exceptional financial performance (Rangone, 1999). In addition, It encompasses the continuous enhancement of the resources and capabilities that a company holds and utilizes to exploit opportunities for developing new innovative outputs (Koc, 2007). The company's intangible property is essential in making such a development. Using this property is also an integral component of innovation capability (Saunila & Ukko, 2012). Innovation aids companies in dealing with the trouble triggered by external factors; hence it is an essential element contributing to the overall business success, primarily in a volatile market (Darroch & Mcnaughton, 2002; Keiningham et. al., 2020).

In the connected global ecosystem, the market is highly competitive and unpredictable. Innovation is the means to meet such market demand, hence innovation

capabilities are the key factor for the competitive advantage (Rajapathirana & Hui, 2018). Innovation capability requires significant spending on R&D, and it signifies an organization's capability to build innovative tools & products to accomplish exceptional financial performance (Rangone, 1999). In addition, it encompasses the continuous enhancement of the resources and capabilities that a company holds and utilizes to exploit opportunities for developing new innovative outputs (Koc, 2007).

The organization's intangible property is the essential factor in making such development. Using this property is also an integral component of innovation capability (Saunila & Ukko, 2012). Innovation aids companies in dealing with the trouble triggered by external factors, hence it is an essential element contributing to the overall business success, primarily in a volatile market (Darroch & Mcnaughton, 2002; Keiningham et. al., 2020).

The concept of innovation capability (IC) has been approached from multiple perspectives and can be considered as a multi-faceted construct (Saunila, 2016). Broadly, the IC is classified as radical innovation and incremental innovation (Pascual-Fernández et. al., 2021; Quintane et. al., 2011). Radical innovation refers to developing entirely new expertise and building something that doesn't exist; or introducing disruption to an existing technical path that enables current products/services to become obsolete (Damanpour, 1991; Mendoza-Silva, 2020).

On the other hand, incremental innovation refers to enhancing the effectiveness of present products by utilizing the insights from the end-users and creating better and more attractive solutions full of novelty, leading to significant profits (Acemoglu et. al., 2020; Lee, 2011; Mendoza-Silva, 2020). The dual-core innovation theory lists innovation into two components, i.e., management innovation and technical innovation (Kalay, 2016). Technological innovation pertains to innovation in organizations' products, services, or processes corresponding to production, whereas administrative innovation relates to business processes beyond production (Kalay, 2016; Lee, 2011).

Administrative innovations indirectly boost technical innovations; hence, both management and technological innovation are essential and complement each other (Damanpour, 1991). A study suggests five components of IC: Product innovation (create or enhance existing products through modification), market innovation (approaches for advertisement and promotion of products through identification of new market opportunities), service innovation (usefulness of service processes), process innovation (expansion or enhancement of a production or delivery technique) and organizational innovation (creation of a new organizational technique related to everyday tasks, work environment, or possible external relations) (Mendoza-Silva, 2021).

The creation of patents by companies indicates that such companies are somewhat profoundly investing in innovations. Also, such companies are spending some money on research and development. According to Gautam & Curba, innovation refers to the commercialization of solutions (Ahuja & Lampert, 2001). Therefore, in general, R&D expenses and patents are considered innovation indicators (Kleinknecht et. al., 2002). The reason is that, through R&D activities, one reaches the stage of applying for a patent. The patent documents contain factual information about the innovation process evaluated by a patent office of a government organization (Kang & Motohashi, 2014). Of course, patents could not be the absolute indicator of innovation. But companies spending on research and development as well as the number of patent filings signify somewhat the overall innovation. According to John Adams, former executive vice president of Honda America Manufacturing, few companies delay filing patents about new ideas or solutions, so the world does not know what the company is doing (Heller, 2022).

Table 1 signifies various companies' rapid launch of the new mobile handset from 1973 until 2020. These companies spend time and money on research & development (R&D) activities as well as filing patents. As a result, each company launched one of the best mobile phones in the past and continued its innovation journey. In this innovation journey, many products created a wow moment for customers and significant business growth in the overall business. Unfortunately, when the product was not welcomed by customers, then losing the market share was observed.

II. Literature Review regarding R&D, Patents and Potential Impacts on Innovation

Table 1: Literature Review Summary

Journal / Publication Group	Author	Title	Review Summary	Gap
Elsevier	Hagedoorn & Cloodt, 2003).	Measuring innovative performance: is there an advantage in using multiple indicators	A few indicators, such as patent citations count and research and development (R&D) expenditures, signify that high-tech companies are innovating	Further research can help investigate the usefulness of the current indicators in industries other than high-tech sectors. For example, "What is the impact of the R&D expense on the market share?" subject requires further research without hi-tech companies.
Rochester Institute of Technology	(Traore, 2020)	Assessing the Status of Autonomous Vehicles Innovation Using Patent Data	The transportation companies are experiencing an extraordinary transformation as researchers in the field expect the adoption of autonomous vehicles (A.V.). The key purpose of the study is to assess the current status of A.V. innovations in the U.S. market. There has been a substantial rise in autonomous automobile patents approved by USPTO since 2010. The number of patents from 2010 to 2018 increased by about 18 folds from 27 to 516.	A study requires further investigation about the relation of innovation with patents in industries other than these A.V. and other countries.
Elsevier	(Kessler & Sperling, 2016)	Tracking U.S. biofuel innovation through patents	A research study summarises the history of biofuels innovation in the United States. The patent filing data in the study suggests a significant innovation activity in the biofuel industry and a later considerable decline in innovation. Furthermore, the study indicates that well-classified patents can act as a good indicator of technological shifts and overall innovation activity within a sector. Finally, the study suggests the need for additional R&D expenses as an investment to see the growth and expansion of the 2nd generation of biofuel.	The study's focus is on the patent data to understand the degree of innovation. In addition, the research is limited to the U.S. and the biofuels industry. Therefore, further study should investigate the relation between R&D expense and filed patents in sectors other than the biofuels and different countries.
Elsevier	(Kang, 2015)	The innovation process of Huawei and ZTE: Patent data analysis	Considering the Patent data of two companies in China, Huawei and ZTE, a study indicates Huawei is an innovative company. But, the patent data is not consistent enough to say that ZTE is an innovative company. The study also suggests that Huawei primarily uses the R&D outcome of ZTE. As a	The focus is on the patent data to understand the degree of innovation of two telecom companies in China. Unfortunately, the research is limited to two companies in a communist country China. A similar study should investigate the role of R&D expense

			communist country, China has some control and influence over companies like ZTE and Huawei.	and patent filing in companies' overall growth by considering telecom companies' worldwide data and not limiting it to a single country.
China Economic Review	(Dang & Motohashi, 2015b)	Patent statistics: A good indicator for innovation in China? Patent subsidy program impacts on patent quality	A study in china shows that to some extent, the patent count is correlated with R&D input and financial output, suggesting that patent statistics are an informative indicator of innovations in China. In contrast, the quality of patents is deteriorated and raises many questions because of the 30% increase in patent counts driven by Govt policy.	The study suggests that the government subsidy has increased the number of patents and the R&D expenses. But how it affected the overall innovation requires further research. The research is focused on Chinese large and medium-sized enterprises under local patent subsidy programs. Further study in the global context, the data may reveal a different outcome.
Springer Open	(Park et al., 2018)	Relation of R&D expense to turnover and number of listed companies in all industrial fields	A study indicates that the world's top 10 listed companies with top spending on their R&D in industrial fields have achieved higher financial growth corresponding to their R& D spending. At the same time, it suggests that spending significant money on R&D may help the company increase its turnover and get listed as a public company.	Similar research with companies operating in the non-industrial field or/and non-listed and their spending on R&D may show a contrasting result.
The Asian Journal of Technology Management	(Rijanto, 2018)	Innovation Driven Enterprise, Sustainable Business and Firm Financial Performance.	A study regarding Indonesian companies' R&D spending and Innovation was conducted. Companies considered in the research have been in the business for at least 34 years and have low debt. In addition, research in Indonesia's emerging market reveals that innovation-driven company's research & development expenses show a +ve correlation with company financial performance.	Similar research considering data from more developing countries or data mix of a developed and developing nation can shed additional light on the R&D expense its relation to the company's growth
International Review of Applied Economics	(Lambert, 2020)	Monopoly capital and Innovation: an exploratory assessment of R&D effectiveness	Research shows that large U.S. companies are spending money on research and development activities, indicating positive impacts on the corporate share prices and profits. But, at the same time, it shows contradicting or negative influences concerning job creation and potential small business creation.	Similar research in other developed countries or developing countries, or a mix of developed and developing countries may shed additional information

Source: Authors' own compilation

IV. Research Hypothesis

The paper assumes that the innovative activities corresponding to R&D expenses and patents of mobile companies have a positive effect on the market share. Hence, the following research hypotheses and variables are proposed:

Table 2: Research Hypotheses and Variables

Research Hypotheses	Variables
H1: There exists a positive correlation between R&D expenses and increased patent filings with the market share of mobile companies.	% Market Share, Number of Patents, and R&D Expenses
H0: There is no positive correlation between R&D expenses and increased patent filings with the market share of mobile companies.	% Market Share, Number of Patents, and R&D Expenses

Source: Authors' own compilation

V. Analysis Method

The study applies the correlation technique to analyze the data, highlighting the nature of the relationship between the market share and innovation through R&D expense and the number of patents. The correlation between two variables is +ve when the variables change in an identical direction. For example, when one variable surges, the other also surges, and the further declines when one declines. The correlation between two variables is -ve when mutually the variables change in the contrary direction. For example, when one variable surges, the other declines, and when one declines, the other surges. The correlation computes the forte and nature of the affinity amid the two-dimension variable quantity that ranges between -1 to +1 (PennState, n.d.; Sayantika B, 2022).

In this study, the correlation result is positive, which signifies that the variable is positively related to the market share. In contrast, the negative correlation is negatively associated with the market share. The correlation matrix is prepared with the help of the "Corr function" in the Microsoft Excel tool. Furthermore, the descriptive statistics like mean, max, min, and stddev are prepared using descriptive statistics in the Microsoft Excel tool. Finally, the correlation is used to identify the strength and direction of the linear relationship between the continuous variables, i.e. market share, patents, R&D expenses for distinct brands such as Apple, Samsung, Nokia and Blackberry). After conducting correlation analyses between the two variables using the below formula, this paper shows the matrix for distinct brands:

$$rxy = \sum(xi - \bar{x})(yi-\bar{y})/\sqrt{\sum(xi - \bar{x})^2\sum(yi-\bar{y})^2}$$

Where;

rxy - Correlation coefficient of linear relationship between variables x and y

xi - Values of the x-variable in the sample

$\bar{x}$ - Mean of values of x-variable

yi - Values of y-variable in the sample

$\bar{y}$ - Mean of values of y-variable

VI. Analysis of Four Significant Mobile Companies

This paper considers four well-known phone brands to understand their competitiveness with ten years of data sets regarding market share, patents and R&D expenses (Federica Laricchia, 2022b, 2022a; GreyB, 2022c, 2022a, 2022b; Justina Alexandra Sava, 2022; Nils-Gerrit Wunsch, 2021; Statcounter GlobalStats, 2022; Thomas Alsop, 2022).

Nokia

Nokia is a Finnish company founded by Fredrik Idestam in 1865. The name Nokia originates from a town called Nokia and the Nokianvirta river in Finland (Borhanuddin et al., 2016). Traditionally, Nokia business units were paper, cables, rubber, televisions, telecom networks, phones, etc., that have transitioned and transformed into mobile telecommunication infrastructure and mobile handsets (Aspara et al., 2011). However, after numerous years of spectacular success and rising market share in the mobile phone market space, Nokia failed for the transition stage in terms of new era of phones to satisfy customers and keep them loyal to the brand (Doz & Kosonen, 2008).

Table 3: Nokia Ten Years Data (2010-2019)

Year	% Market Share	R&D Spending (in million US dollars)	No. of Patents
2010	37,02	75	6.250
2011	38,23	71	6.470
2012	29,91	61	7.471
2013	21,43	33	6.794
2014	13,70	20	5.988
2015	9,24	24	4.497
2016	5,54	53	3.745
2017	2,53	60	3.913
2018	1,47	52	3.883
2019	1,08	50	3.078

Source: Authors' own compilation

**Nokia % Market Share Month-Wise Data is transformed to annually

Table 4: Nokia Descriptive Statistics

	% Market Share	R&D Spending (in million US dollars)	No. of Patents
mean	16,01	49,90	5.208
std	14,66	18,75	1.547
min	1,08	20,00	3.078
max	38,23	75,00	7.471

Source: SPSS Software Output

Table 5: Nokia Correlations of Variables

	% Market Share	R&D Spending (in million US dollars)	No. of Patents
% Market Share	1,00		
R&D Spending (in million US dollars)	0,45	1,00	
No. of Patents	0,87	0,10	1,00

Source: SPSS Software Output

Samsung

Lee Byung-Chul started a grocery trading store named Samsung Trading Co. in Taegu, Korea, in 1938, primarily involved in trading noodles and other items produced in the city and neighborhoods and exporting them to China regions (Peter Bondarenko, 2021). Samsung marked a footprint in the electronics industry in the 1960s. Later, the telecommunications hardware industry in 1980 and the phone market in 1998 with a phone SPH-1300 (Matthew Burris, 2020; Samsung Newsroom, 2013) reflected Samsun's dominance in the market. Samsung remains one of the largest microprocessor manufacturers globally in the late 20th and early 21st centuries, which signifies that it is a significant player in the mobile phone domain (Bondarenko, 2021).

Table 6: Samsung Ten Years Data (2010-2019)

Year	% Market Share	R&D Spending (in million US dollars)	No. of Patents
2010	4,31	8.460	7.646
2011	10,64	9.260	7.100
2012	18,42	11.060	8.706
2013	25,26	13.750	11.151
2014	32,07	14.260	10.884
2015	31,94	13.810	10.096
2016	32,33	13.750	8.498
2017	32,97	15.620	7.202
2018	30,68	17.340	8.348
2019	31,60	17.500	2.840

Source: Authors' own compilation

**Samsung % Market Share Month-Wise Data is transformed to annually

Table 7: Samsung Descriptive Statistics

	% Market Share	R&D Spending (in million US dollars)	No. of Patents
mean	25,02	13.481	8.247
std	10,37	3.079	2.382
min	4,31	8.460	2.840
max	32,97	17.500	11.151

Source: SPSS Software Output

Table 8: Samsun Correlations of Variables

	% Market Share	R&D Spending (in million US dollars)	No. of Patents
% Market Share	1,00		
R&D Spending (in million US dollars)	0,89	1,00	
Patents	0,07	- 0,20	1,00

Source: SPSS Software Output

RIM (Blackberry)

Mike Lazaridis and Douglas Fregin started a company, Research in Motion (RIM), widely known as Blackberry, a Canadian-based multinational company, in 1984 (McGrath, 2013). Blackberry predominantly provides software and hardware platforms as well as solutions to instant messaging, e-mails, browsing, Internet, intranet-based applications, etc. (Youssef, 2013). Before Apple's phone entered the phone business in 2007, it was a time when almost the entire corporate working people wanted Blackberry because of its unique e-mail features, ease of use, and excellent security (Trivedi, 2017). However, later 2007 onwards, Blackberry could not catch up with the leading innovation appearing in the market, primarily Apple, followed by Google Android (Sarno, 2010). Blackberry tried to tantalize the market in January 2013 with new smartphone models, Z10 and Q10, but it seems it was not enough compared to competitors like Apple and Android phones (Timmer, 2021; Hill, 2013). As a result, Blackberry's phone business collapsed significantly, and the company decided to sell patent assets (Amadeo, 2022).

Table 9: Blackberry Ten Years Data (2010-2019)

Year	%Market Share	R&D Spending (in million US dollars)	No. of Patents
2010	19,40	965	4.337
2011	14,72	1.351	4.916
2012	5,48	1.556	4.633
2013	3,63	1.509	2.565
2014	1,97	1.286	1.002
2015	1,25	711	725
2016	0,81	469	725
2017	0,32	306	624
2018	0,11	239	603
2019	0,04	219	545

Source: Authors' own compilation

**Blackberry % Market Share Month-Wise Data is transformed to annually.

Table 10: Blackberry Descriptive Statistics

	% Market Share	R&D Spending (in million US dollars)	No. of Patents
mean	4,77	861	2.067
std	6,79	539	1.867
min	0,04	219	545
max	19,40	1.556	4.916

Source: SPSS Software Output

Table 11: Blackberry Correlations of Variables

	% Market Share	R&D Spending	No. of Patents
% Market Share	1,00		
R&D Spending	0,47	1,00	
No. of Patents	0,84	0,74	1,00

Source: SPSS Software Output

Apple

The Apple Computer Company was founded by Steve Jobs and Steven Wozniak in 1976. Their first computer circuit board was ready with sales orders for 200 units in two months of working in their garage (Oldcomputers, 2022). Apple was an established brand long before making smartphones. The company started with computers and followed up with iPods, and in the first quarter of 2007 company sold over 21 million iPods, corresponding to 48% of its revenues (Apple Newsroom, 2007). Steve Jobs presented the first iPhone in January 2007, which proved a revolutionary product because it combined the functionalities of the iPod into a small

mobile phone with a touch screen, and it was able to access the internet like a computer (Merchant, 2017). The company launched the iPhone in 2007 as the most advanced "smartphone," featuring many features and capabilities that were many years ahead of its competitors, creating excitement among customers, and becoming a formidable force among competitors (Rarick, 2011).

Table 12: Apple Ten Years Data (2010-2019)

Year	% Market Share	R&D Spending (in million US dollars)	No. of Patents
2010	29,32	1.780	4.171
2011	27,75	2.430	4.519
2012	24,71	3.380	6.424
2013	24,39	4.480	6.095
2014	23,86	6.040	5.562
2015	20,30	8.070	6.080
2016	19,32	10.050	5.812
2017	19,66	11.580	4.814
2018	20,58	14.240	5.233
2019	22,70	16.220	4.727

Source: Authors' own compilation

**Apple % Market Share Month-Wise Data is transformed to annually.

Table 13: Apple Descriptive Statistics

	% Market Share	R&D Spending (in million US dollars)	No. of Patents
mean	23,26	7.827	5.343
std	3,42	5.060	765
min	19,32	1.780	4.171
max	29,32	16.220	6.424

Source: SPSS Software Output

Table 14: Apple Correlations of Variables

	% Market Share	R&D Spending (in million US dollars)	No. of Patents
% Market Share	1,00		
R&D Spending	- 0,75	1,00	
No. of Patents	- 0,41	- 0,08	1,00

Source: SPSS Software Output

VII. Conclusion and Recommendations

The correlation matrix for the companies Nokia, Samsung, and RIM (Blackberry) indicates that R&D spending and patents are correlated positively with the % market share. At the same time, the correlation matrix for the company Apple shows that R&D spending and patents are correlated negatively with the % market share. Out of all four companies, three have a positive correlation, hence both hypotheses tend to be valid.

Mobile phones have transformed considerably from simple to smart for becoming information and communication pivots essential to modern-day life (TigerMobiles, 2019). In the last 30 years, almost all mobile phone companies have launched phones with unique features to entice the end-users and gain market share. As a result, companies have a race to compete and increase their market share by servicing customers with the best phone features, and the race continues (Križanović, 2020; Zaman, 2020).

Moreover, spending money on research, development and patents signifies that companies are working towards innovations to build new products and services. Also, such companies have the potential to stay ahead of their competitors and maintain a competitive edge. Further research considering more than ten years of data and more than four mobile brands shall show a more precise correlation of market share with R&D spending and patents.

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