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Effect of Research Spending on Growth of Manufacturing Industry :

A case study of Toyota and Fiat

Abstract

Research and Development is the soul of any organization. In the current competitive world, it is important to manage the research and development in such a way that the company improves on the core competency as well as develop new products too to enhance the experience of the customer. Furthermore, the research is also needed to improve the process and product efficiency. But not all the research is successful. Only one in the five research project gives the result. This causes a huge dilemma for the management who has to decide the budget to be allocated as R&D expenditure. In many of the companies, the management end up cutting down the R&D expenditure to increase their short term profit.

The aim of this paper is to analyse the effect of R&D spending on the profitability and other financial growth indicators of the company. With the help of literature review, the paper lays the foundation of the study and analyses the views of the experts who believe that R&D expenditure indeed affects the financial growth of the company. The scholars have further expressed that this does not mean that more the investment, more will be the earning, but they suggest that the company should find the right strategy for investment in R&D.

The same is then established with the help of the analysis of the financial data of two manufacturing companies in auto industry—Fiat Chrysler and Toyota Motors. Both the companies have different budget for Research and Development. Various graphs and charts are used to study the influence of the R&D expenditure on the financial parameters like profit, revenue, share value etc. A comparison is made between the expenditure of the two companies and their investment in R&D. The paper further extrapolates the literature review to understand and justify the result of various hypotheses.

After studying the financial reports of both the companies, it is clearly established the revenue is directly affected by the increase in R&D expenditure, and share value does not follow any pattern with regards to such investments. The reason for the same is then identified. Finally the paper, with the help of these findings, expresses that a company can safely and profitably invest 3.5-4.5% of its revenue in the research and development. Amount lesser than this might mean a conservative approach to the research and development, while a higher amount may turn out to be a riskier proposition.

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Abbreviations

OECD: Organization for Economic Co-operation and Development

R & D: Research and Development

TMC: Toyota Motor Corporation

FCA: Fiat Chrysler Automobiles

RORC: Return on Research Capital

Acknowledgement

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Last of all, I would like to express my thanks to the University that provided me a chance to study and present my findings in this thesis.

Chapter 1: Introduction

1.1Background

In this modern world, everybody agrees that research and development is the necessity that helps an organization stay in shape and face the competition. Zahra and Coven(1994)[1] mentioned in their paper that innovation is the "life blood of corporate survival and growth. OECD(1996) acknowledged the importance of knowledge in one of its paper[2] as 'the driver of productivity and economic growth'. The paper further iterated that performance in all sectors including manufacturing and distribution can be maximized with the help of the knowledge and right policies. Niosi (1999) explains that in order to gain this knowledge, Research and Development, or R&D, is the route companies take. This R&D mostly takes place in three places—in-house in the company laboratories, in the university laboratories or in the government laboratories. [3] It is a universally accepted fact that the R & D plays an important role in the long term economic growth. (Czárl&Belovecz, 2007). The innovation is needed in order to meet

[1] Zahra, S.A. and Covin, J.G. (1994). *The financial implications of fit between competitive strategy and innovation types and sources*. The Journal of High Technology Management Research, Vol. 5 No. 2, pp. 183-211.

[2]Organization for Economic Co-operation and Development (1996).*The Knowledge Based Economy*. Retrieved from: http://www.oecd.org/sti/sci-tech/1913021.pdf [17.07.15]
[3]Niosi, Jorge(1999). *Fourth-Generation R&D: From Linear Models to Flexible Innovation*.Journal of Business Research 45, 111–117 (1999)

the customer's demand. It is also needed in order to capitalize the opportunities offered by the changing market and technical platforms (Baregheh, Rowley& Sambrook, 2009)

Smith and Tushman(2005)[4] explain that there are two kind of innovative activities in a firm: exploratory activities and exploitative activities. They further explain that the right balance is needed between the two of these activities as too much of the exploitative activities can mean inertia and conservatism in the organization, while too much of exploration can kill the efficiency of the existing products. Hence the right balance is necessary between the two activities. And this balance is not necessarily needed for the financial outcome. In order to thrive in the competitive environment and create a brand value, exploration is necessary along with exploitation activities.

But Miller and Morris(1999) explains the innovation is facing lot of crisis right now. The track record of R&D is not too good. While everybody understands and acknowledges the importance of the innovation and R&D, the companies are wary about investing money

[4]Smith, Wendy K, Tushman, Michael L.(2005). *Managing Strategic Contradictions: A Top Management Model for Managing Innovation Streams*. Organization Science 16(5), pp. 522–53

in the R&D itself because not every dollar invested in the project gives and output. In fact, Miller and Morris(1999) express their dismay at the situation by citing a researcher who said that billions of dollars have been wasted in these failed attempts to innovate. The fact stands that even the pumping up of billions cannot help a project if the inherent assumption is wrong, or the process used is flawed from the start. They further say that on an average out of 3000 projects, only one project of R&D has chances of succeeding(Miller & Morris, 1999)[5]. Moreover, Czárl&Belovecz (2007)[6] explains that there is a huge lag between R&D and growth and hence it is difficult to measure the true effect of the R & D on the economic growth. This has created a sense of futility across the R & D practices and has further painted a dismal picture of R&D and its contribution.

But despite of all kind of risk associated with the R & D measures, the R & D plays a very important role, especially in manufacturing industry where it can be used to reduce the cost of manufacturing itself and introduce new features in the product. With the three kind of

[5] Miller, William L., Morris, Langdon. (1999). 4th Generation R&D: managing Knowledge, Technology, and Innovation. John Wiley & Sons: New Delhi.

[6] Czárl, Adrienn, Belovecz, Mária (2007), *Role of Research and Development in the 21st Century* ,RevistaInformaticaEconomică, nr. 4 (44). Retrievable from:http://revistaie.ase.ro/content/44/2%20BELOVECZ.pdf

innovations—product, service and process, it is indeed possible to offer the best product at the competitive price.

1.2Declaration of Problem

The current research triesto find the relationship between research spending and compare it to various growth factors such as profits, sales and share value so as to understand how much R&D can actually impact the economic growth of the company. For this purpose, two major car manufacturing companies of Toyota and Fiat Chrysler are chosen as case studies. Both the companies have different approach towards the Research and Development. While Toyota is considered the leader in the field of Research and Development, Fiat's expenditure in the field of R & D is comparatively lesser . Their R&D laboratories span the world, and they are known for their huge investment in the field of research and development. This R&D is not only focused on the product, but also on the process and organizational changes so as to improve the efficiency of the whole system.

The research compares the performance of both the companies for a period of nine years. The research shows the different approaches to R&D spending by Toyota, Fiat Chrysler and compares their corresponding profits and brand value.

1.3Research Objectives and Questions of Dissertation

The main objective of the research is to find if there is any relationship between R&D expenditure to the growth of the manufacturing companies Toyota and Fiat Chrysler. By comparing the two R&D expenditure and various growth indicators, it will be easy to surmise how the investment in R&D can affect the company's growth.

1.3.1 Research Objectives

The research objectives of the report are as follows:

1. To compare R&D expenditure to growth factors.
2. To understand the effects of year after year expenditure on R&D on brand value of the companies.
3. To define an effective R&D spend percentage

1.3.2 Research Questions

In order to achieve the same, the major question the paper tries to answer through the various sections are:-

- Does R&D expenditure really effect the growth of the company?
- What is the effect of sales each year on R&D spending?

- Does increasing R&D expenditure each year help with the profits?
- What is the future perspective of R&D spending in the manufacturing industry?
- Can an effective R&D spend percentage be derived from the research?
- How effective was the R&D spending in Toyota and Fiat each year?
- What is the different R&D approaches in each company?

1.4. Structure of Report

The paper is divided into five different sections. The first part is the **introduction** that attempts to explain the whole research procedure and structure in short. This is followed by the **literature review** of the relevant literature available. This literature review will provide the necessary framework and information that will help in conducting the research and cover all the major points required for understanding the relation between R&D and the company's growth. The third part of the research explains the **research methodology** and how the data for the research was collected.

This section is followed by the **Result and Analysis** section where the different findings of the paper are discussed and elaborated on. The paper is closed with the last section of **Conclusion** where finally the

relation between the R&D expenditure and company's economic growth is summed on.

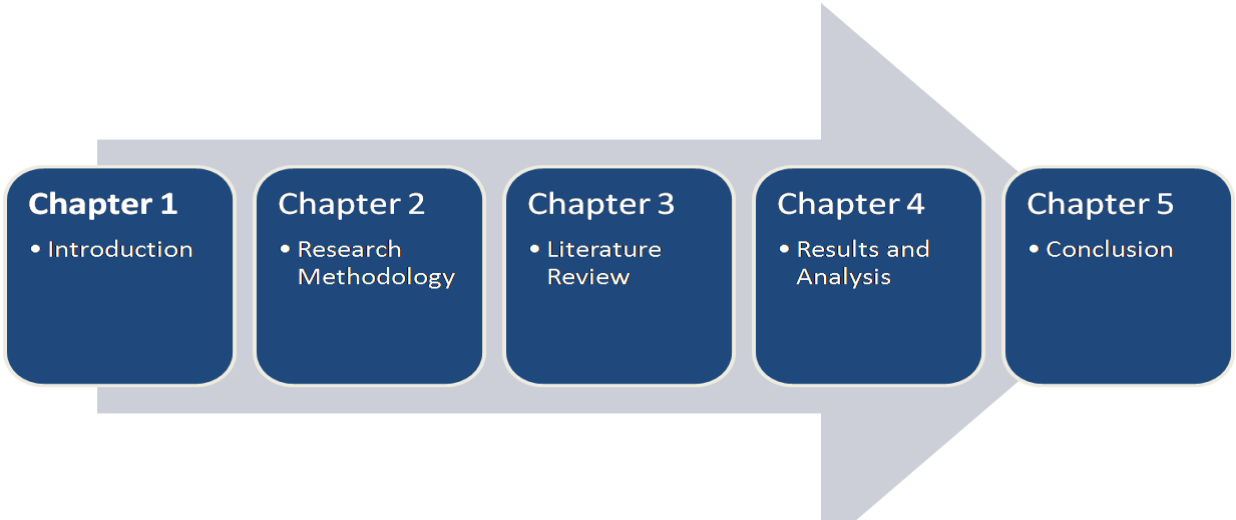


Figure 1: Methodological Overview of Research Paper

Chapter 2: Research Methodology

2.1 Introduction

Kothari(2004)[7] defines research as 'search for knowledge'. He further explains that research is the search for specific information about a particular topic. As explained above in the introduction, the purpose of this research is to find the relation between R&D expenditure to the growth of the manufacturing companies by taking Toyota and Fiat Chrysler as the examples and to do a comparative study on them.

It is hoped that the research would enable to understand the various effects of R&D spending on a company's growth factors, and would also help in calculating an effective R&D spend percentage.

This chapter reviews the research approach and methodology used for the research. The first part of the chapter explains the need and necessity of the literature review for the paper, while the next part of the chapter focuses on the research method used and the various aspects of the selected method.

2.2 Literature Review: Need and Importance

A literature review is the systematic method of identifying and evaluating the existing works of scholars and practitioners (Fink,

[7] Kothari, C.R. (2004). Research Methodology: Methods and Techniques.New age international (P) Ltd.: Delhi, India.

2010)[8]. Yin (2012)[9] explains that literature review is necessary for research. It helps in forming the sharper question with regards to the research. He further explains that the literature provides the necessary framework to ask the questions and helps in understanding the key concept and theories associated with the research matter, thereby providing the complete understanding of the subject matter. Thus, literature review helps in laying the building blocks for the research.

For the purpose of current paper, the literature review was carried out extensively to understand the process of R&D and to understand the opinion of the scholars on the impact of R&D over the economic growth of the companies.

The literature review also takes into account the existing information about the automobile industry with special focus on Toyota and Fiat.

2.3 Motivation of Research

Kothari(2012) explains that every research has its motivation that makes the researcher select that particular subject. The motivation for this research came from the dilemma surrounding around R&D expenditure. On one hand, R&D expenditure is considered necessary for the growth of the company, but despite this there is a lot of

[8] Fink, Arlene(2010). Conducting Research Literature Reviews. Sage Publication, Inc. : United Kingdom.
[9] Yin, K.R. (2012).Application of Case Study Research.Sage Publication, Inc: United Kingdom.

thought because of the risk involved in the R&D itself as more than half of R&D project do not succeed.

2.4 Methodology

A research can be divided into many types based on the various features of the research.

i) Analytical versus Descriptive research: Kothari(2012) explains While descriptive research involves all kinds of surveys and fact-finding enquiries, while the analytic research includes use of facts and information that is already available in the market.

ii) Quantitative versus qualitative research: Quantitative research is based on measurement of quantity or amount while qualitative research is associated with phenomenon related to quality or kind.

iii) Inductive versus the deductive research: One can select between inductive and deductive research approach while proceeding the research question. Deductive research starts from either a well-established (or assumed) theory that is established based on the law and then tested to confirm the existing theory. Inductive approach works in the opposite manner and moves from the observation to establish the hypothesis and finally eneralize the law. In short, inductive

approach is used for building the theory, while the deductive approach is used for the testing the existing theory. The report uses the inductive approach as it uses the two companies' data to generalize the final information.

The current research focuses on mainly the quantitative and analytical in nature. Nonetheless, consideration to qualitative research is also given as the researcher feels that the same is needed to truly understand the result of the quantitative analysis.

The data is collected from various sources about the investment in R&D and the growth indicators of the companies like Sales, Net Profit, and Share Value etc. Taking three years as the reference base, these growth indicators are then compared with each other vis-à-vis the R&D expenditure. A comparison is also made between the R&D expenditure of the two companies along with their growth indicators.

The qualitative portion of the research analyzes the difference between R&D approaches of the two companies and tries to infer if this difference in the R&D approach can contribute to the difference in growth factor of the company.

2.5 Data Collection and Sampling

There are mainly two types of data collection methods available: Primary Data Collection and secondary data collection. Primary data includes direct collection of the data by the researcher, while the

secondary data collection include studying the data already collected for various other purposes. Following diagram shows the different kind of secondary data collection options available to the researcher:

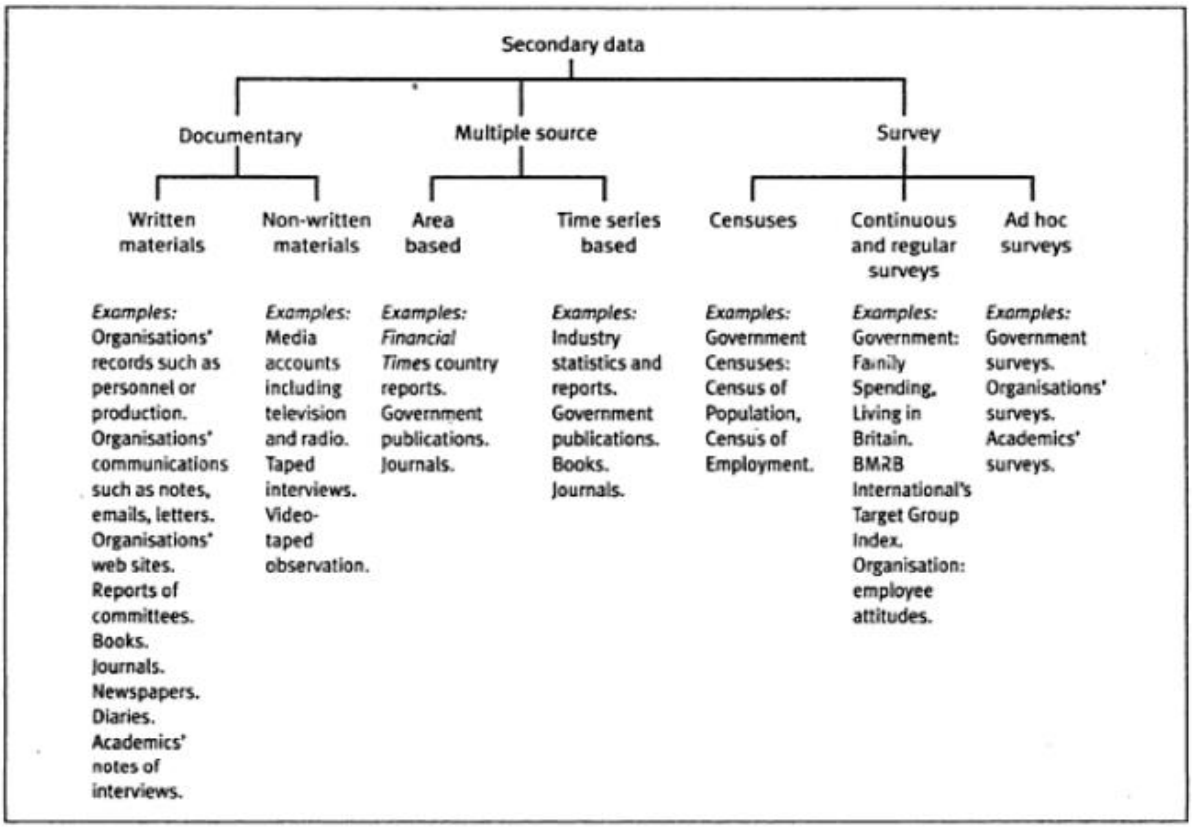


Figure 2: Various Sources of Secondary Data[10]

The data for the research was collected from secondary sources. No primary data collection methods were used. The major source of the

[10] Saunders, Mark, Lewis, Phillip, Thornhill, Adrian (2003). *Research Methods for Business Students.*Pearson Education Limited: India.

quantitative information was the annual reports of the companies for past years. These annual reports provided the information about the investment in R&D for each year and the sales and net profit. The annual report also gave an idea about the companies' expectations from the recent R&D policies.

The indicators like share values were taken from the website of Yahoo Finance for the comparison. Various newspaper/magazine articles were also studied in order to understand the direction R&D of each company was taking and how was it affecting the company's brand value in general.

2.6 Limitation of the Research

Although every care has been taken to present all the facts, the research suffers from the limitation arising because of the usage of the secondary data. The data about the R&D expenditure has been taken from the annual reports and other newspaper/online articles available. There is a possibility of the data being doctored but because of the secret nature of the information, there was no other mean for data collection available.

Another problem that was faced during the analysis was the currency variation. Toyota reported its data in terms of Japanese Yen, and Fiat reported its data in Euros. Although they did give the USD conversion rates used in the reports, that rate has been defined at the time of the

report generation in case of Toyota and has been averaged in case of Fiat. This might not be the faithful conversion of the operating income and the R&D investment in USD for both the companies. There is no means to include the currency variation rate in the comparison.

Another limitation faced during research was the share value of Fiat that is available only after 2009, when they acquired the part of Chrysler. Because of this, the research for Toyota spans 9 years for share value comparison as well, while that of Fiat spans only past five years.

Apart from this, there was no ethical issue encountered in the course of research.

Chapter 3: Literature Review

3.1Introduction

The following subsections attempt to understand the various aspects associated with Research and Development activities. The purpose is to understand the kind of changes R&D has gone through over the time and the role it plays in the overall development of the company. The chapter begins with understanding what exactly R&D involves and then moves on to the changes that have taken place over the course of time.

The next step is to understand different kinds of the R&D methods and strategies. These will help in carrying out the qualitative analysis of both the firms. The next section looks at the various available literatures describing the effect of R&D on the profitability of the firm. In the end, a subsection is introduced to explain the R&D status in the automobile industry as defined by "Top 1000 innovations".

All these information together will provide the necessary base to conduct our analysis on.

3.2Role and Importance of R&D

Dictionary defines Research and Development as 'work directed towards the innovation, introduction, and improvement of products and processes,' and that encompasses the exact role of R&D.

Research and Development activities focus on finding innovative solutions and improvements in the products and the processes to improve the efficiency of the process or to provide the new and better products to their customers.

Moreover, in the current framework of rising competition, it is imperative for the organization to innovate and develop new products and systems that will help them in staying ahead of their competitors(Bettis and Hitt, 1995)[11]. With the globalization and technological advancement, this need for innovation as increased further. Niossi(1999) clearly explains that the company follows the route of research and development to bring about the required innovation for success.

OECD(2010) has also stressed on the need of the research and development and its role in the overall growth of economy. They have clearly mentioned that cutting the corners with R&D investment might help the companies in short term, but such a strategy harms both the economy and the company in the long run.

[11]Bettis, R.A. and Hitt, M.A. (1995).The New Competitive Landscape. Strategic Management Journal 16:7–19 (Special Summer Issue)

3.3 Changes in R&D Process: From First Generation to Fifth Generation

With the change in the technological situations, R&D processes have also undergone a huge change. During 1950s, since the demand was higher than the supply, R&D was treated as an overhead cost, where in it was considered that more the money goes in R&D, more will be the number of products generated.

As the demand and supply curves balanced themselves out, the competition grew fierce in the coming years. The R&D during that time shifted to fine-tuning of the products as per the market demand. Rather than developing products on its own, R&D was more focused on fulfilling the customer's expectations during this stage. Project management was introduced to measure the result of R&D during this period.

The next stage of R&D involved focusing on the cost cutting and the other measures throughout the organization. This involved studying of the technological processes throughout the organization in order to develop the right kind of cost-cutting measures. This brought R&D closer to the organization making them more linked and interaction-focused. Here the R&D was developed as a whole process affecting all the functions throughout the organizations.

The fifth generation R&D became far more interactive taking into account the role of competitors, distributors, customers, suppliers etc. and aimed towards complete integration of all these factors in the system.

Thus, we can see that the perspective on managing R&D processes has changed over the years, moving from a technology-centered model to a more interaction-focused view.

R&D Generations	Context	Process Characteristics
First generation	Black hole demand (1950 to mid- 1960s)	R&D as ivory tower, technology-push oriented, seen as an overhead cost, having little or no interaction with the rest of the company or overall strategy. Focus on scientific breakthroughs.
Second generation	Market shares battle (mid-1960s to early 1970s)	R&D as business, market-pull oriented, and strategy-driven from the business side, all under the umbrella of project management and the internal customer concept.
Third generation	Rationalization efforts (mid-1970s to mid-1980s)	R&D as portfolio, moving away from individual projects view, and with linkages to both business and corporate strategies. Risk-reward and similar methods guide the overall investments.
Fourth generation	Time-based struggle (early 1980s to mid-1990s)	R&D as integrative activity, learning from and with customers, moving away from a product focus to a total concept focus, where activities are conducted in parallel by cross-functional teams.
Fifth generation	Systems integration (mid-1990s onward)	R&D as network, focusing on collaboration within a wider system – involving competitors, suppliers, distributors, etc. The ability to control product development speed is imperative, separating R from D.

Figure 3: Change in R&D over the period of Time

3.4. R&D Strategy

Formulating an R&D strategy has become one of the most difficult decisions for the management. Every management knows the importance of this research and development and yet finds it most difficult to assign the budget to the R&D performance. Because of the challenges faced in R & D, the organizations have moved between

one strategy to another—sometime centralizing, sometimes decentralizing the process while at other time completely re-engineering the process to show the results(Pissano& Figgie, 2012).[12] The major challenges faced by R &D can be listed out as follows:

i) Delays in Results: R&D is a job of long timescales. It takes huge amount of time before there is something to show for the entire R&D taking place across the different laboratories and R&D centres. Moreover, testing a result developed by R&D also takes a long time to declare it a success or failure (Loch & Tapper, 2000) [13]This makes a long time before the person realizes whether the R&D strategy has been successful or not.

ii) Uncertainty associated with other functions: R&D does not function alone. For the success of R&D of product, function or the process itself, there are many other factors that play an important role along with R&D.

iii) Risk associated with the failure of the project: Not all that goes in R&D comes across as a product. In fact many of the R&D projects never get to see the light of the day. Many of them, even developed, are rejected after being developed, because the end product looks different from what was

[12]Pissano, Gary P., Figgie, Harry E.(2012). Creating an R&D Strategy. Working Paper from Havard Business Review

[13]Loch, Cristoph H., Tapper, U.A Staffan, (2000). R & D Performance measures that are linked to strategy. INSEAD: France.

conceptualized. In short, the R&D is a risky job. It involves a lot of risk in terms of time of the management and the amount of money spent in the R&D.

iv) Difficulty in the measurement of the Real Correlation: Utterback and Abernathy(1975) explains that the results of companies' innovation strategies is also dependent upon the external environment.Since R&D is a long-term process and it is not an independent function, it is very difficult to measure the impact of R&D in terms of the financial growth or brand value. Instead, these are slowly felt in an organization over the small period of time.

With the ageing of the firms, they tend to turn more conservative towards the plans and policies. As the initial zeal of the founding members is replaced by the logic of professional manager, the emergence of invention and innovations turn slower.(Graves and Langowitz, 1993)[14] With time, there is also more demand of existing product lines and the focus to the R&D shifts(Acs and GifFiat, 1996).[15]

[14]Graves, S.B. and Langowitz, N.S. (1993). Innovative Productivity and Returns to Scale in the pharmaceutical Industry. Strategic Management Journal 14(8):593–605

[15]Acs, Z.J. and Gifford, S. (1996). Innovation of Entrepreneurial Firms. Small Business Economics 8(3):203–218.

In order to understand the R &D strategy of an organization, the various features of R&D strategy should be observed:

- ***Architecture:-***Architecture means the location and process of R&D is structured, whether it is centralized or decentralized and which geographical location the R&D takes place in. (Pisano, 2012). This part also focuses on what will be size, location and the focus of each R&D unit.

  One of the major dilemmas faced by R&D strategists is the decision between global and local. While there is no denying the fact that the global R&D helps in utilizing the best of what is available in the world, almost every R&D product needs localization as per the region. This is specifically true in the manufacturing industry. The architecture decision involves the amount of autonomy both local as well as the global R&D centres are allowed (Zedtwitz, Gassmann&Boutellior, 2004)

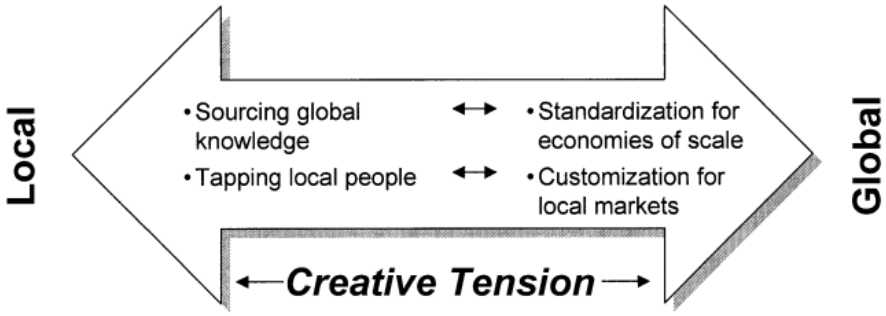


Figure 4: Local versus Global Project: An R&D Strategic Decision

- ***Processes*** are the formal and informal strategic ways according to which the R&D is carried out. This includes deciding what kind of review the R&D will undergo, how much tightly will be the R&D team controlled, what kind of metrics and indicators will be used for the measurement of the performance of these processes. It is generally observed that the control increases with the increased risk in the project. Riskier the project, tighter is the control by the management. This risk can be in the form of the investment or in terms of the internal acceptance.
- ***People,*** like in any other process, forms an important as well as necessary part of the R&D process. Despite all kind of sophisticated technology available, R&D is a people intensive process. Thus it is important to attract and retain the right kind of talent for R&D. The people related strategy of R&D projects mean what kind of people are selected, what is their technical background, what kind of training is organized for them and what are the are obviously an enormously important job guarantees offered to them to retain these employees. These policies have a great impact on the kind of performance of the R&D department. Ideas form the core of the R&D department and these ideas can truly be developed if the people working in R&D department have the creative freedom.

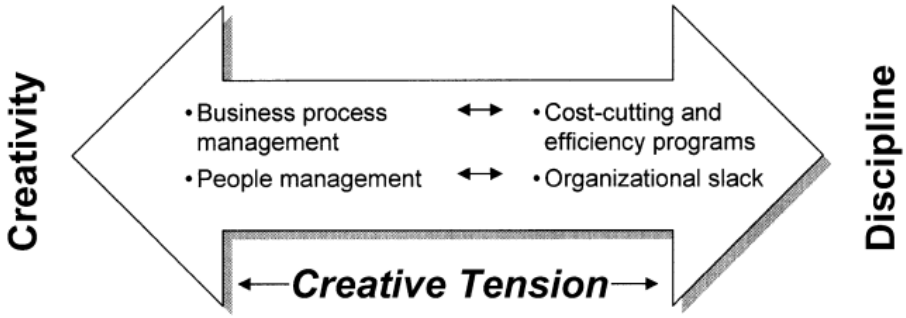


Figure 5: Creativity versus Discipline-- An R&D Strategy Decision

- ***Portfolio*** to the resources allocated to the R&D department and the projects undertaken by them. Portfolio strategy decides what kind of projects will be undertaken by the R&D department of the company.

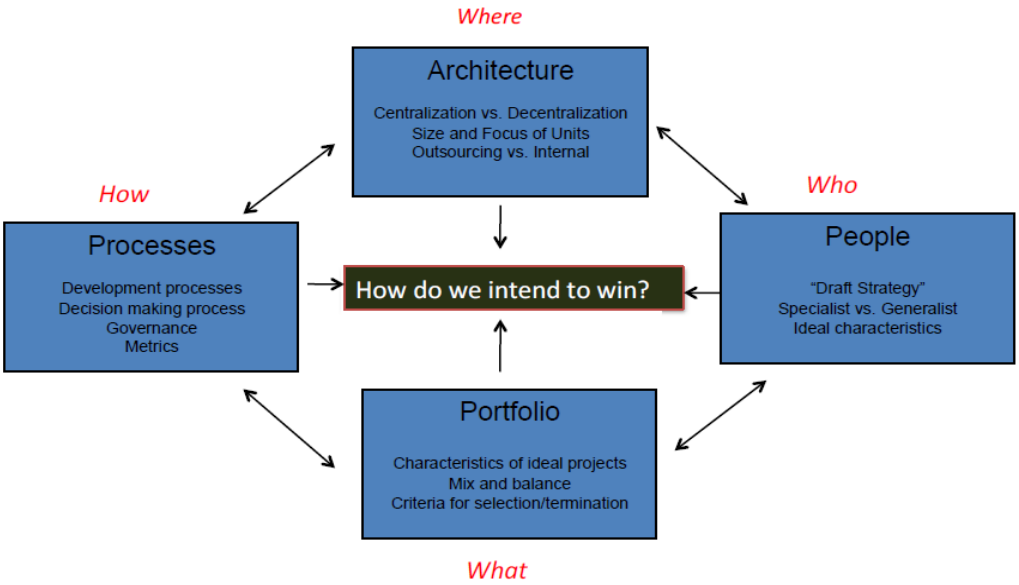


Figure 6: Elements of R&D Strategy

3.5R&D and Profitability: A look at Past Studies and Viewpoints

Before embarking on the analysis, it is important to understand how the scholars view the research and development and if they consider R&D as an indicator for the economic growth of the company. This will provide us in forming the basic framework needed for our research. Mansfield(1962)[16] expresses that R&D expenditure has been explored and studied by many economists in their studies. Most of them agree that the R&D expenditure have the positive impact on the growth of the company. A few of such papers and examples are listed below.

Mansfield (1980)[17] and Griliches (1986)[18] concluded that the R&D spending has the direct impact on the firms' capability of innovation which further affects the productivity of an organization.

Hall, Griliches, and Hausman (1986)[19]claim that whatever an organization spends on the research and development is considered as

[16]Mansfield, E. (1962). Entry, Gibrat's Law, Innovation, and the Growth of Firms. American Economic Review55(5):1023–1051

[17]Mansfield, E. (1980). Basic Research and Productivity Increase inManufacturing.American Economic Review70(5):863–873.

[18]Griliches, Z. (1986). Productivity, R&D, and Basic Research at theFirm Level in the 1970s.American Economic Review76(1):141–154.

an investment as it adds to the stock of the knowledge in the firm. Similarly Rosenburg(1990)[20] claims that not R&D not only helps in creating the knowledge bank required for the development of the project, but also helps in evaluation and development of the potential opportunities to implement the knowledge.

But many of the scholars agree on the fact that the higher R&D expenditure does not always translate to better performance, because R&D is a risky affair. If it has the capability to help the companies to rise, it also has the power to give higher performance losses to the company. What matters more is how much is the productivity of research and development activities in the longer run. (Investopedia,2010)[21]

The same fact is expressed by Jazulbeki(2014)[22] as well wherein he states that their research has shown that investment in research and development alone does not mean higher returns. It is more about how

[19]Griliches, Z., Hall, B., and Pakes, A. (1991). R&D, Patents, and Market Value Revisited: Is There A Second (Technological Opportunity) Factor?Journal of Economics of Innovation and NewTechnology1:183–201

[20]Rosenberg, N. (1990). Why Do Firms Do Basic Research (with TheirOwn Money)?Research Policy19(2):165–174

[21] McClure, Ben. "R & D Spending and Profitability: what's the Link?" Investopedia. Com. Retrieved from: http://www.investopedia.com/articles/fundamental-analysis/10/research-development-rorc.asp#ixzz3glZRjH3w [24.07.15]

[22] Strategy&. (2014) 2014 Global Innovation 1000.A Strategy Report.

the money is invested and whether the right areas are chosen for the investment or not.

3.6Research and Development in Automobiles Industry

In 2014, as per Strategy&(2014) report, the five industries showed the rise in the R&D spending : software and internet, chemicals and energy, industrials, and auto. The investment in R &D industry has been rise since a decade.

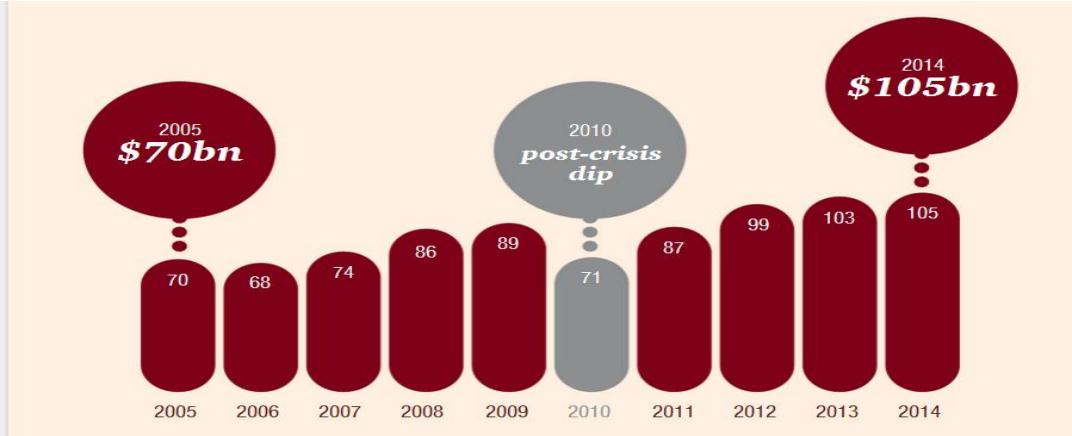


Figure 7: Investment in R & D for Automobile Industry

The reason for this can be seen in the forces ruling the auto industry: consumer demand, fuel economy. Innovation can help the automobile companies in such a competitive environment. Even today the demand for lower fuel consumption and increased safety of vehicle is on rise and hence it can be predicted safely that the research and development will still be in rise in this industry.

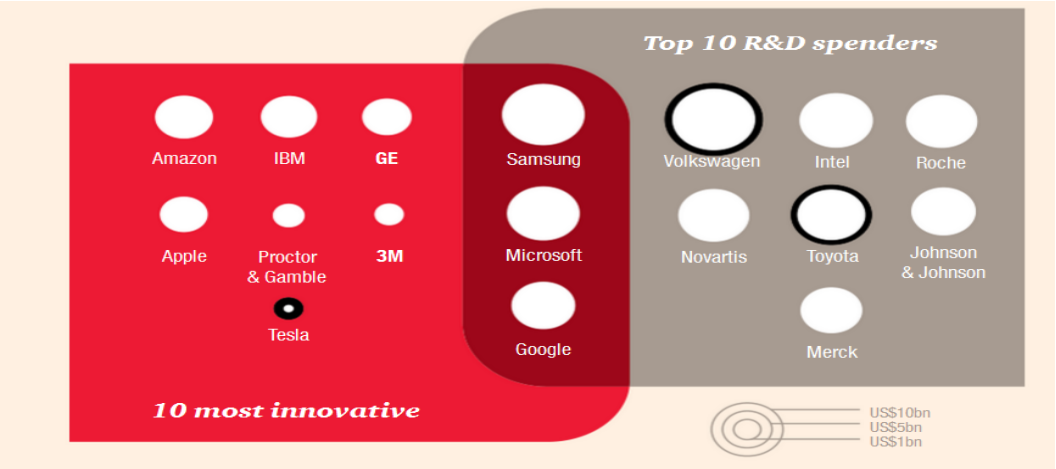


Figure 8: Top R&D Spenders of 2014 out of which 3 are from Automobile Industry

The report further stated that the automotive companies believed that they were moving in the right direction. The report also stated that the companies believe that they have seen improvement in their financial achievements as well. This shows that there indeed shows that companies perceive that there is a relation between the growth of the company and the amount spent in the R&D.

3.7 Conclusion

In order to understand the need of research and development in the market, various literature was analyzed. The major source of literature used are as follows:

i) Scholarly Articles on Research and its Impact on the Financial Results of the company.

ii) The past papers and researches that analyze the similar data for different industries.

iii) The books to understand the concept of research and various problems associated with it.

iv) The magazine articles published online about the subject.

The above literature review clearly indicates that there is some kind of relation between the expenditure in R&D and the company's financial performance. Although nobody has indicated a certain amount required for investment, it is generally agreed that the investment alone does not contribute to the increased performance, but R&D in right direction, after understanding the industry and market situation, can indeed contribute to the success of the company.

Chapter 4: Results and Analysis

4.1Introduction

This section analyzes the various data available in order to find the answer to the research questions introduced in chapter 1. The literature illustrated in previous chapter is used as the base to analyze the available data and carry on the final analysis. Since Automobiles is one of the top investors in the field of R&D, the same has been selected as the area to analyze the impact of the R&D on company's finances. Also, two companies of Fiat and Toyota are selected. The two companies which the research focuses on are Fiat Chrysler and Toyota Motors. While Fiat is the Italian brand with comparably lower spending in terms of R&D, Toyota has always been considered as the leader in innovation. This scenario presents two contrasting cases to analyze the approach towards R&D. Although initially it was suggested to use three years as the scale to analyze the performance of these companies, it was observed that longer duration was needed to correctly interpret the results and hence the current data involves study of both the companies over the period of past nine years. The share value feature for Fiat is not available for earlier years and hence the same is analyzed from 2010 itself.

4.2Toyota and Fiat:A comparison of R&D Expenditure

Toyota Motors, also known as TMC, is one of the world's leading auto manufacturer with its headquarters located in Aichi, Japan. Toyota is a company that is known for its innovation. According to the Strategy&(2014), it is one of the top spenders in the field of Research and Development. The following table indicates the investment in Research and Development field of the company for the period of past 9 years. Following table presents an overview of amount the company invests in the R&D:

Table 1: TMC's Investment in R&D 2006-2014

Year	Toyota's Investment in R & D(in Billion Yen)
2006	812.6
2007	890.7
2008	958.8
2009	904
2010	725.3
2011	730.3
2012	779.8
2013	807.4
2014	910.5

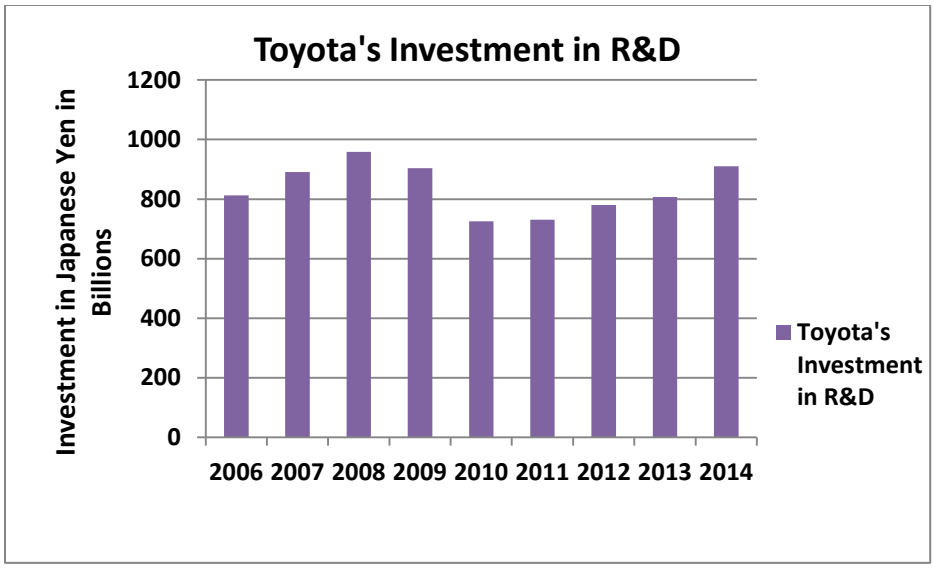
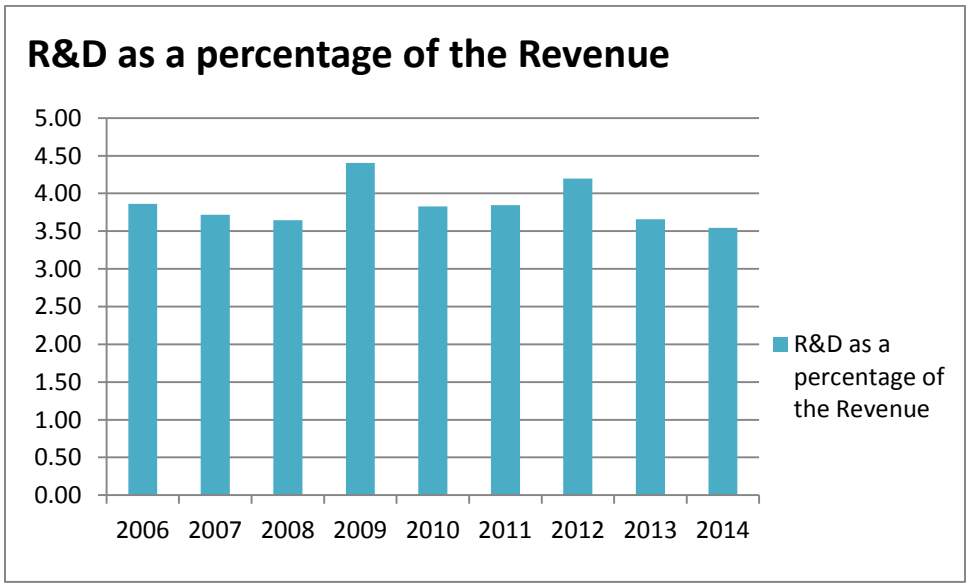


Figure 9: Histogram showing Toyota's Investment in R&D

If the histogram is plotted with the R&D investment as a percentage of revenue, it is seen that the percentage of amount invested in R&D has been between 3.5-4.5% of the revenues of that year.



This shows a constant commitment of the company towards the Research and Development Activities. An analysis was done to understand the areas that R&D focused on. The annual report of 2014 states that "To ensure efficient progress in R&D activities, TMC coordinate and integrate all phases, from basic research to forward-looking technology and product development." The reports also clearly indicate that Toyota not only works for the product development in its own facilities, it also provides the necessary support to its suppliers and vendors. Moreover, Toyota is also known for its process innovation which helped it to cut down the losses and increase the overall efficiency of the project. (Annual Report, 2014)

Toyota follows the global strategy for its R&D development. The company has multiple R&D center, each focusing on different areas of the production and process. While some of the centers are limited to the value engineering and modification of the vehicles as per the local needs, the basic research and planning is carried on in the headquarters. (Toyota Research and Development bases, n.p.)[23]

Also Toyota aims at providing continuous and incremental growth to its employees. The code of conduct of Toyota clearly mentions that all

[23]Toyota Global.com.Research and Development Bases. Retrieved from: http://www.toyota-global.com/company/history_of_toyota/75years/data/automotive_business/products_technology/research/bases/index.html[22.07.15]

employees work with the aim of meeting the customer expectation and innovating the whole process.

Thus in short, the culture in Toyota fosters innovation not only by investment in R&D, but also by global participation and employee support.

4.3Introduction to FiatChrysler and its R&D investment

Fiat group has been manufacturing cars since 1908 and is known all over the world for its different car models. In 2014, Fiat and Chryler combined hands to form Fiat Chrysler Automobiles or FCA and became the seventh largest manufacturer in the automobile industry. If we take a look at the area of focus for the company, we will notice the word "sustainable mobility" repeated over and over again.[24] This is the main area where the company is expanding its research. The company has been steadily investing in R&D of the products. The same can be seen in the following Table indicates the investment of Fiat in terms of R&D.

[24]FCA.com. Innovation Highlights. Retrieved from: http://www.fcagroup.com/en-US/innovation/Pages/default.aspx [24.07.15]

Table 2: Fiat's Investment in R&D

Year	Fiat's Investment in R&D (In Million Euros)
2006	1591
2007	1741
2008	1986
2009	1692
2010	1936
2011	2175
2012	1858
2013	2236
2014	2537

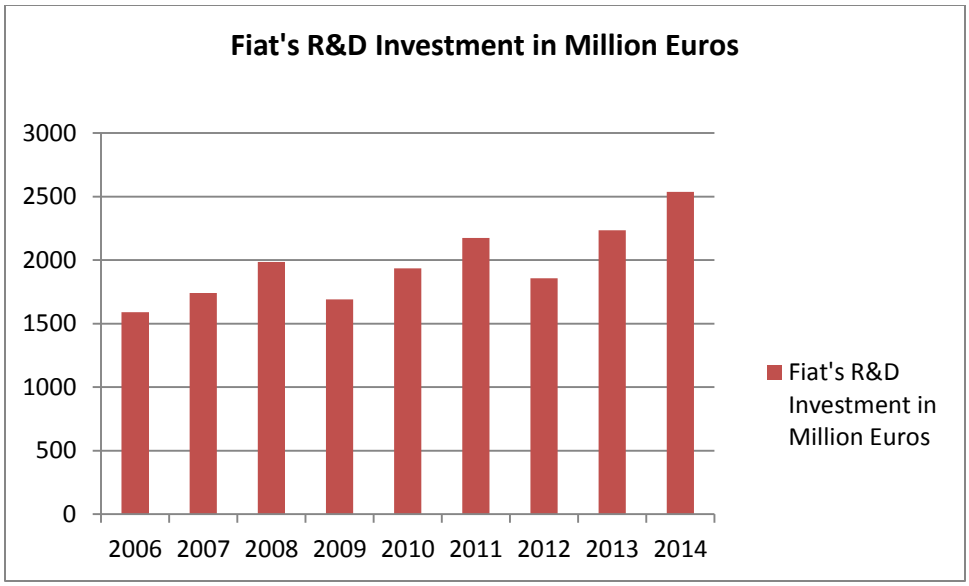


Figure 10:Histogram of Fiat's Investment in R&D

Fiatbelieves in a customer centric research. All their research is based on the feedback received from the customers. The R&D itself gets interchanged between different departments including the operation department.

Fiat has research centers in India, Brazil and Turkey in addition to the center in Italy. There are other research centers as well, it total being the 85 centers. These centers employed around 20,000 employees in 2013.

Today, the company has global R&D centers, but all are under the centralized operation.

4.4 Comparison between Toyota and Fiat Research Expenditure

Following is the graphical comparison of the R&D investment of the two companies, TMC and the Fiat Chrysler.

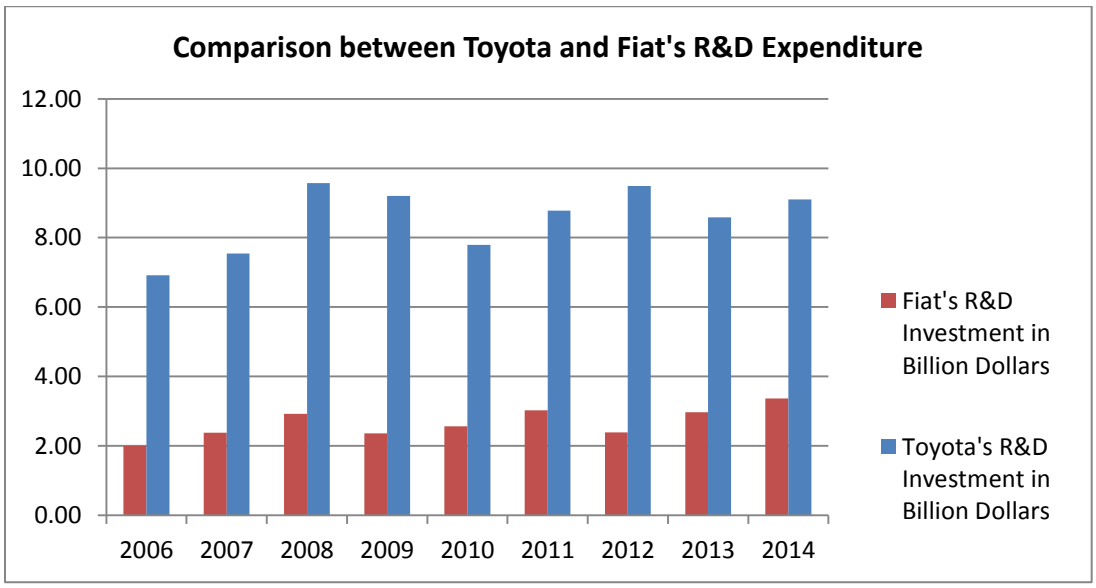


Figure 11: Comparison between Toyota and Fiat's R&D Spending

As evident from the above, Toyota spends much higher amounts in terms of R&D, but a look at the percentage of the R&D expenditure with respect to the revenue indicates that Fiat's expenditure in terms of percentage of revenue is also less. While Toyota's expenditure in R&D lies somewhere between 3.5-4.5, for Fiat this R&D expenditure is limited to 2.5-3.5%.

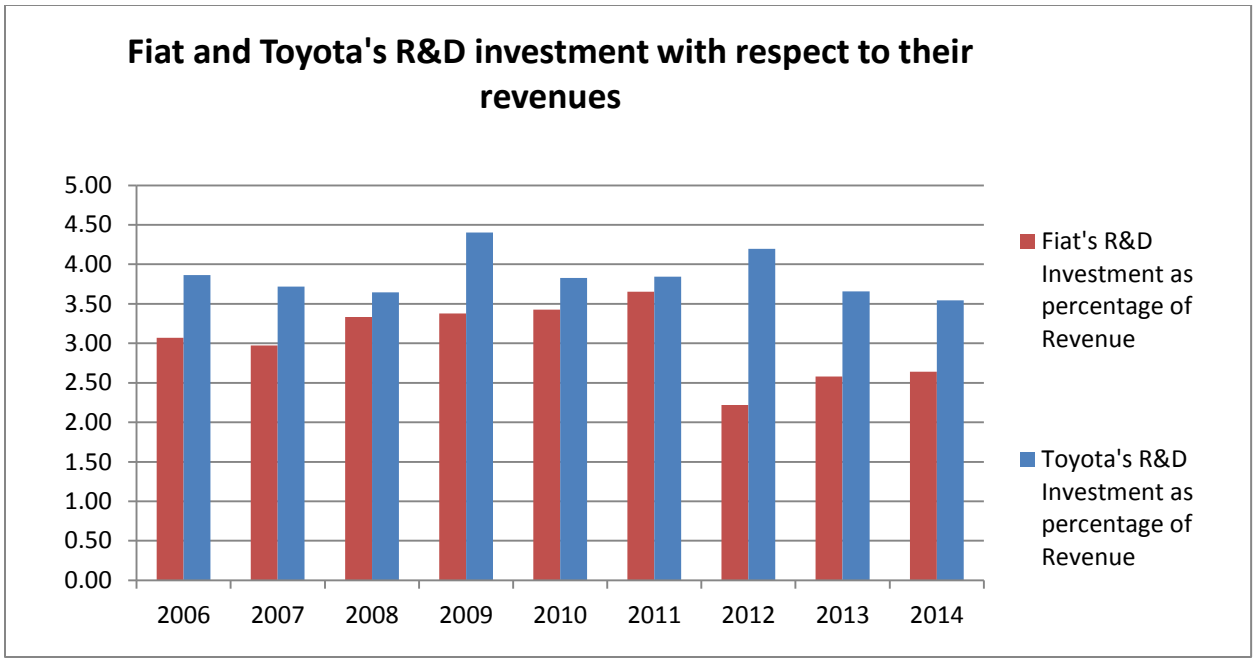


Figure 12: Comparison Between Fiat and Toyota's R&D investment with respect to their revenue

Moreover, a look at the annual reports indicates that the company continued investment even during the difficult period of 2009 and 2010, when even Toyota had reduced their share in the R&D.

4.5Return on Research Capital: A link between Profitability and R&D Expenditure

As explained in the literature review, most of the investment gurus believe that it is difficult to find the relation between the profitability of the company and the research investment. Moreover, the literature suggests that R&D expenditure alone is not sufficient for generating sales and profits. In order to cope up with this issue of R&D, the metric of RORC or Return on Research Capital was introduced. The metric can be defined as the ratio between gross profit of the current year and the R&D expenditure of the previous year. This helps in understanding how much profit did each dollar invested in R&D generated. Using the R&D investment of last year as the base gives the necessary time required for converting the research into the profits. (Investopedia,2010)[25]

Following table indicates the RORC for both the companies over the period of time.

[25]McCure, Ben. (2010). R&D Spending and Profitability: What is the link? Investoperdia.com. Retrieved from: http://www.investopedia.com/articles/fundamental-analysis/10/research-development-rorc.asp [22.07.15]

Table 3: RORC for Fiat and Toyota from 2007-2014

Year	Fiat's RORC	Toyota's RORC
2007	1.98	2.75
2008	1.71	2.55
2009	0.18	-0.48
2010	1.19	0.16
2011	1.13	0.65
2012	0.70	0.49
2013	0.55	1.69
2014	0.53	2.84
Average of all years	**0.99**	**1.33**

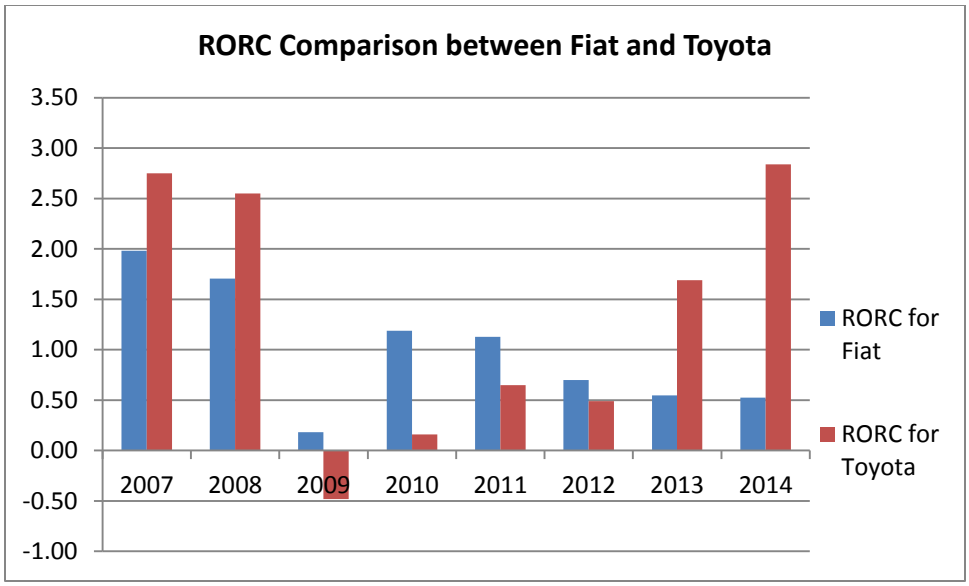


Figure 13: Comparison of RORC for Toyota and Fiat

A look at the RORC average for the two companies clearly indicate that even though the investment is higher for the Toyota in terms of R&D expenditure, the Return on Investment are higher for Fiat for certain years. Only Toyota suffered the negative return on Research Capital over one year, but a look at the histogram clearly indicates that Fiat's investment in Research seems to have slowed down as the RORC has gone down drastically and is yet to achieve the previous success.

4.6 Comparison of Financial Performance vis-à-vis R&D expenditure

The following section's compares the financial performance with the R&D expenditure taking the financial performance of Toyota and

Fiatas the reference. The data used for constructing these graphs is indicated in Appendices 1 and 2, where in the major financial parameters of both the companies are listed out for past nine years.

Each hypothesis is listed and tested out in the following section using those figures.

Hypothesis 1:The revenue increases with increase in the R&D expenditure.

Toyota's Case

The following table shows the revenue and R&D investment.

Year	Toyota's Investment in R & D (in Billion Yen)	Revenue in billions of Yen
2006	812.6	21,036.91
2007	890.7	23,948.09
2008	958.8	26,289.24
2009	904	20,529.57
2010	725.3	18,950.97
2011	730.3	18,993.69

2012	779.8	18,583.65
2013	807.4	22,064.19
2014	910.5	25,691.91

Since the scale of both the figures varies too much, the scale of the figure is altered by plotting the revenue is plotted as 1/100th of its original value.

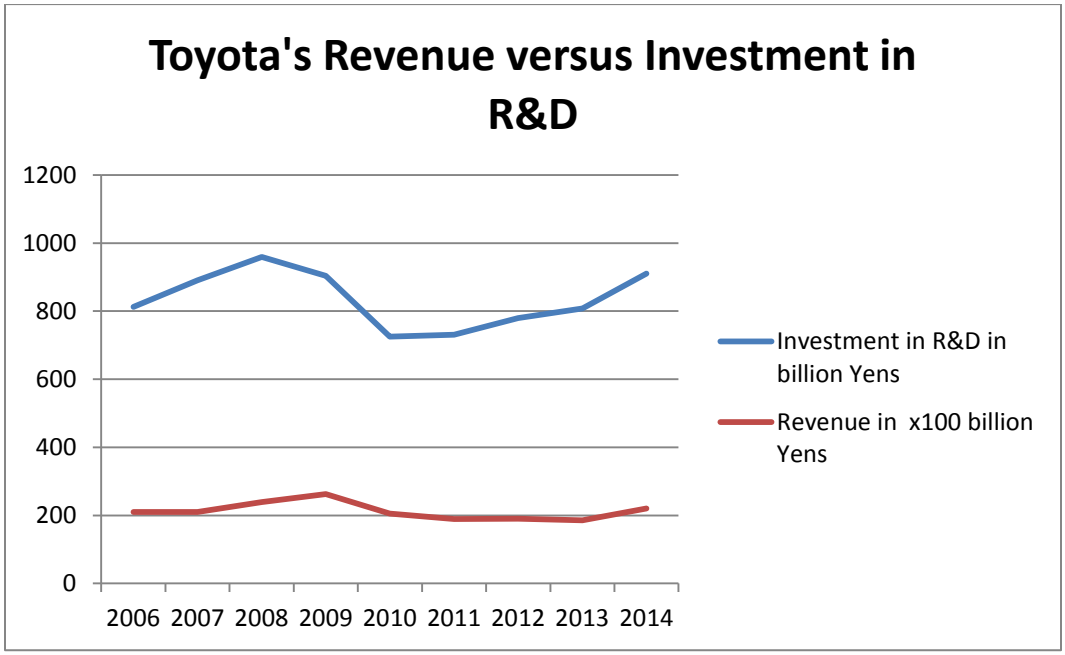


Figure 14: Graph comparing Revenue versus Investment in R&D

The above figure indicates that although there is no faithful translation of investment in R&D in terms of revenue, but the revenue graph indeed follows the ups and downs of the R&D expenditure graph.

Another factor which is noticed it that the effect in revenue is reflected almost a year after the affect in R&D expenditure.

This goes with what we learnt from our literature review as well. R&D methods take time to get to fruition.

Fiat's case

Following table indicates the value of R&D expenditure and the revenues of the company for the period from 2009-2015.

Year	Fiat's Investment in R&D (In Million Euros)	Revenue in dollars in millions Euros
2006	1591	51832
2007	1741	58529
2008	1986	59564
2009	1692	50102
2010	1936	56528
2011	2175	59559
2012	1858	83765

2013	2236	86624
2014	2537	96090

Like Toyota, the scale of the graph has been modified to make it comparable to the R&D investment while plotting the two options.

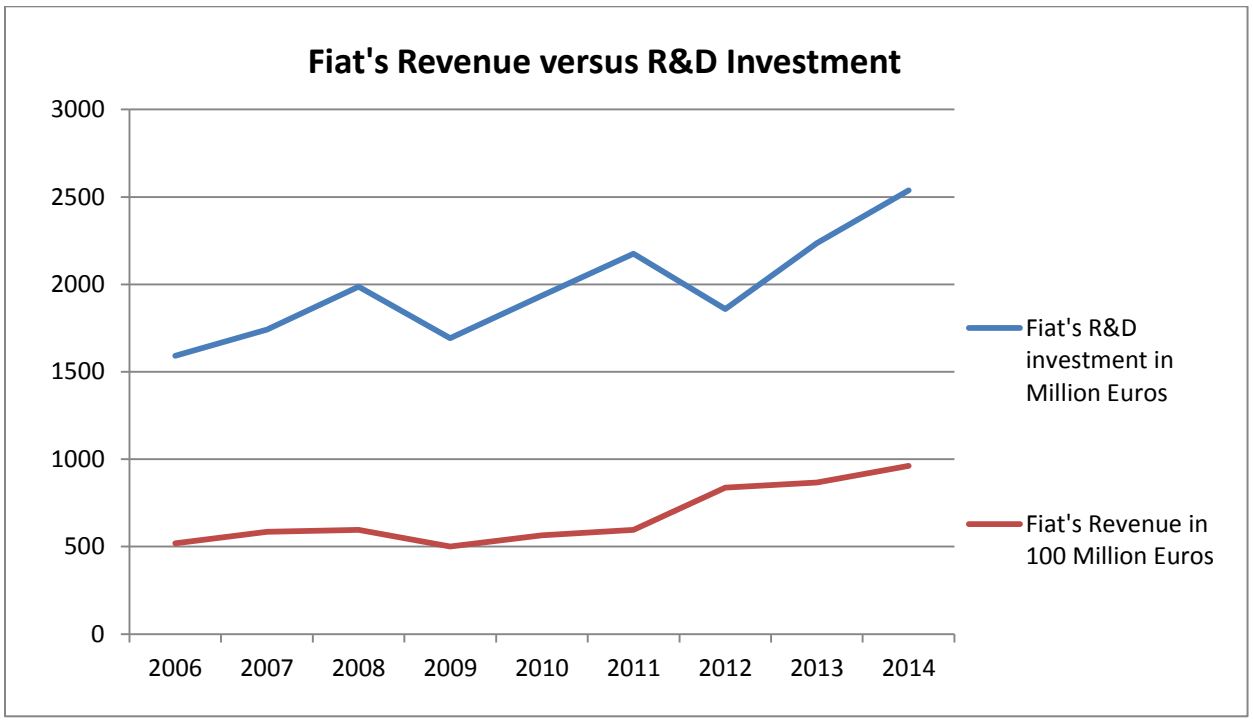


Figure 15: Fiat's Revenue versus R&D Investment

The figure indicates the similar result as seen in case of Toyota. The revenues indeed follow the investment in R&D.

Hypothesis Result

Above two graphs indeed show that the R&D activities affect the revenue. There might not be a proportional relation between the revenue and the R&D expenditure, but change in revenue indeed follows the change in R&D expenditure.

Hypothesis 2: Share Value increases with the increase in expenditure.

Toyota's case

The following graph indicates the share value corresponding to the R&D investment of that month.

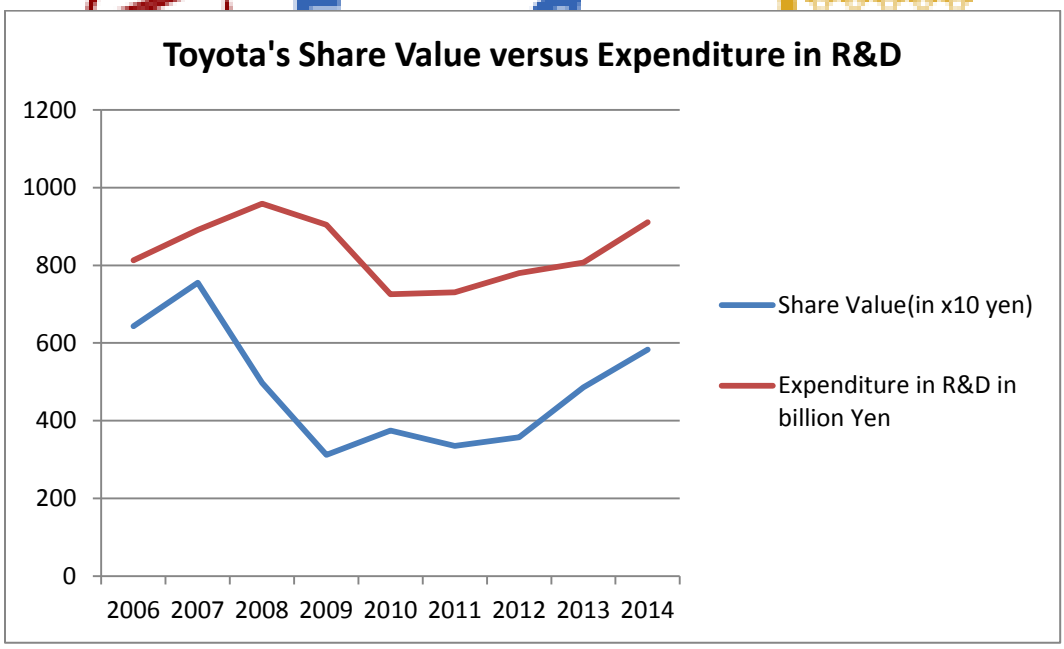


Figure 16: Share Value versus R&D Expenditure For Toyota

The above graph does not show any concrete relation between the share value and the R&D expenditure. The rise and drop in share value does not seem to affected by the R&D expenditure directly.

Fiat's Case

For Fiat the data of past five years is compared from the time it acquired 58% of Chrysler. Fiat's graph shows similar trend as that of Toyota. There seem to be no relation between the share value and research and development expenditure as well.

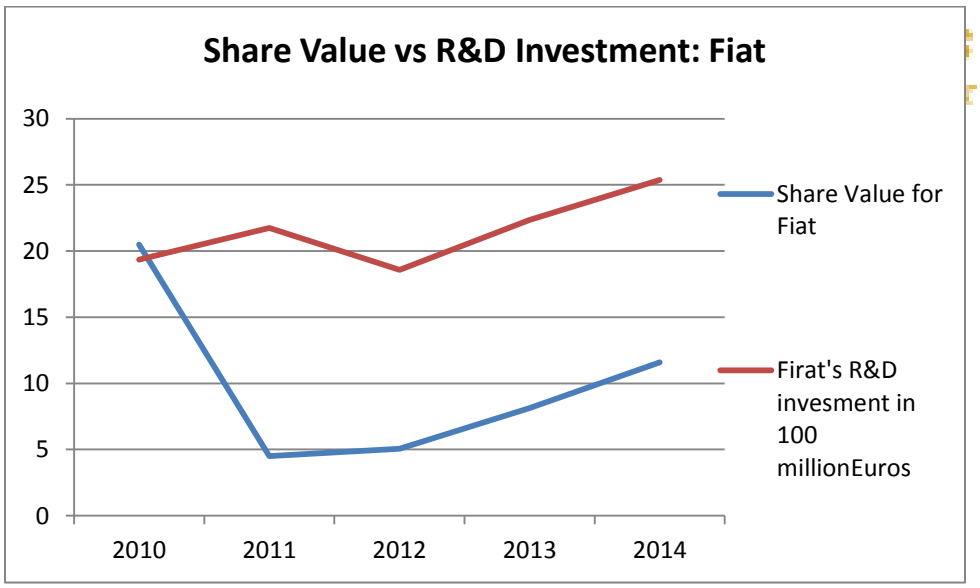


Figure 17: Share Value vs R&D Expenditure of Fiat

Hypothesis Result

Above two graphs indeed show that the there is no direct relation between the R&D expenditure and the share values. This goes with what we learnt in the literature review as well. Share values are the result of multiple factors and R&D expenditure does not get transformed into results overnight. The results might be different in case of a discontinuous innovation, but with continuous innovation not much change is felt in the share value.

Hypothesis 3: Higher Research Expenditure means higher profitability.

Toyota

Due to huge variation in the scale of the data, both research expenditure and operating cash flow are plotted separately to get an idea about their relation.

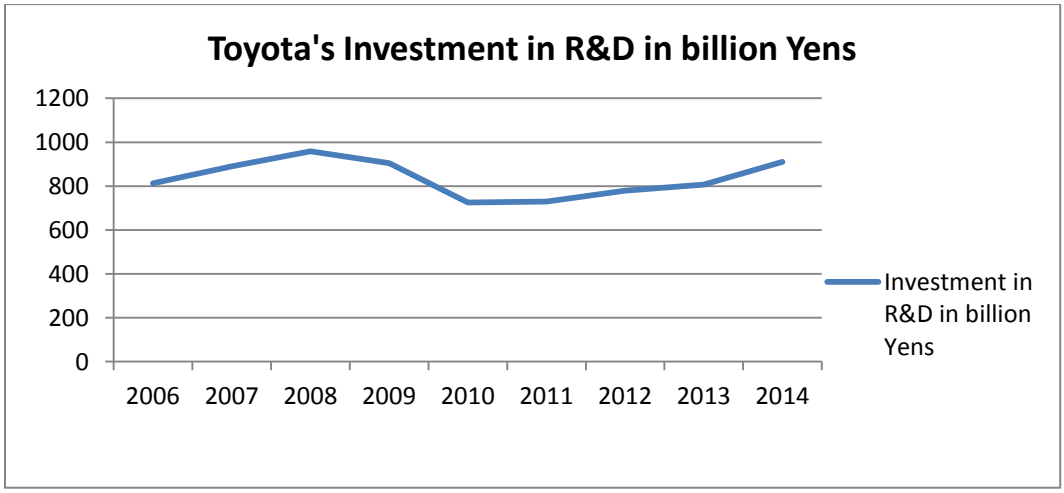


Figure 18: Graph showing Toyota's R&D investment

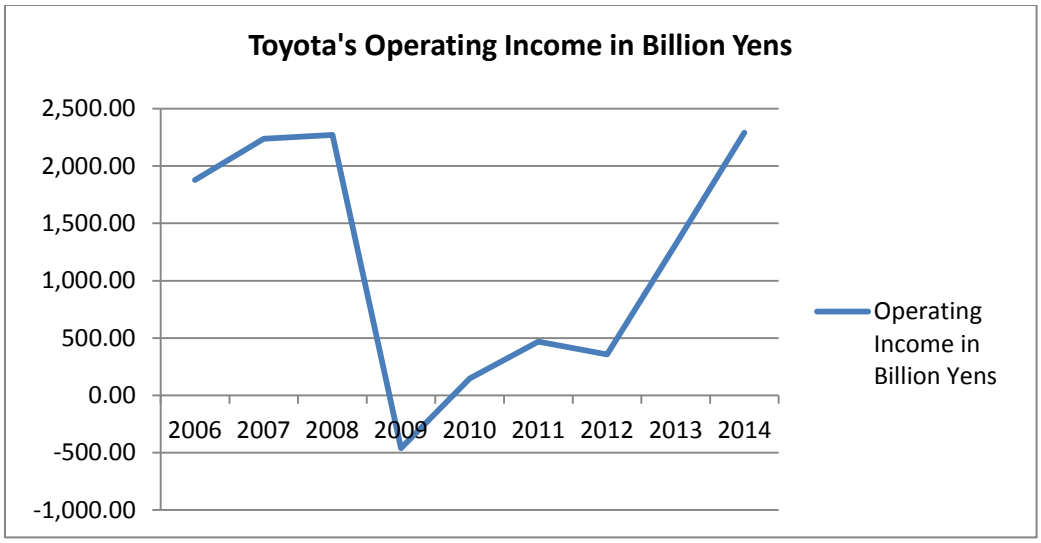


Figure 19: Graph indicating Toyota's Operating Income

As seen from the above graph, there is no real correlation visible between the operating income of the firm and R&D expenditure.

Fiat

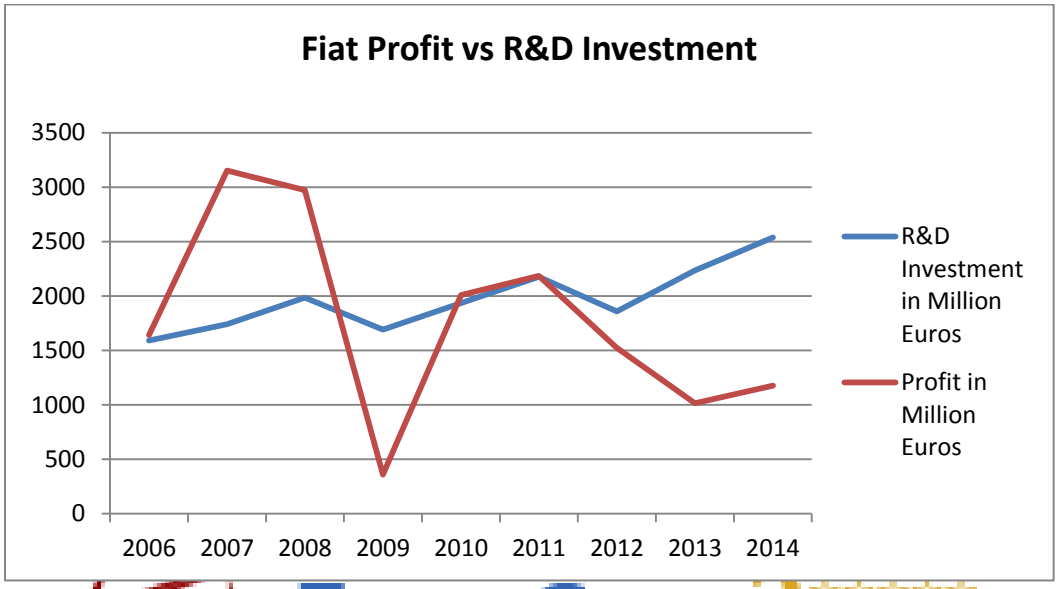


Figure 20: Fiat Profit vs R&D Investment Graph

As the above graph indicates there does not seem to be any relation between the profit and the R&D of the same or the following year, although it does seem to follow the similar path.

Hypothesis Result

Above two graphs indeed show that the there is no direct relation between the R&D expenditure and the operating income of the company. This goes with what we learnt in the literature review as well. Operating incomes are the result of multiple factors and R&D expenditure does not get transformed into results overnight. The

results might be different in case of a discontinuous innovation, but with continuous innovation not much change is felt in the share value.

Hypothesis 4: Higher Return on Research Capital means higher share value.

Toyota

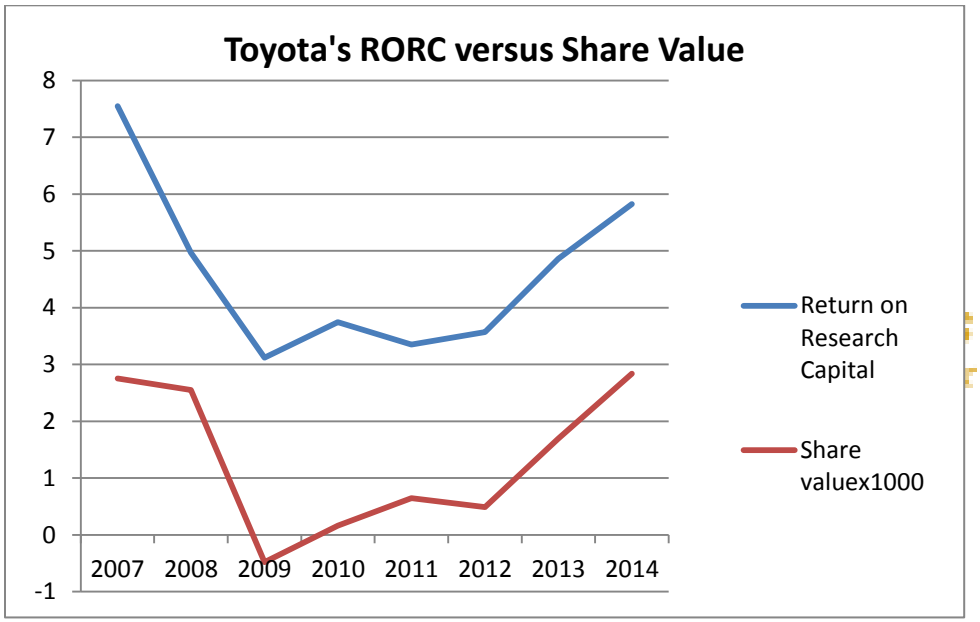


Figure 21: Toyota's Share Value versus RORC graph

The above graph indicates a direct relation between RORC and share value. As the RORC varies, the share value follows the same trend. This clearly indicates that the shareholder cares more about the return on research capital than the invested capital itself.

Fiat

Fiat graph shows a bit different scenario than that of the Toyota. Here the share value does not seem affected by the RORC, but not that faithfully or that proportionally. One reason for this could be the heavy loss suffered by US automobile companies in 2009-2010 during which the fluctuations in share values are seen with a sharp dip during 2010. Also a sharp dip is seen in 2008 in the share values.

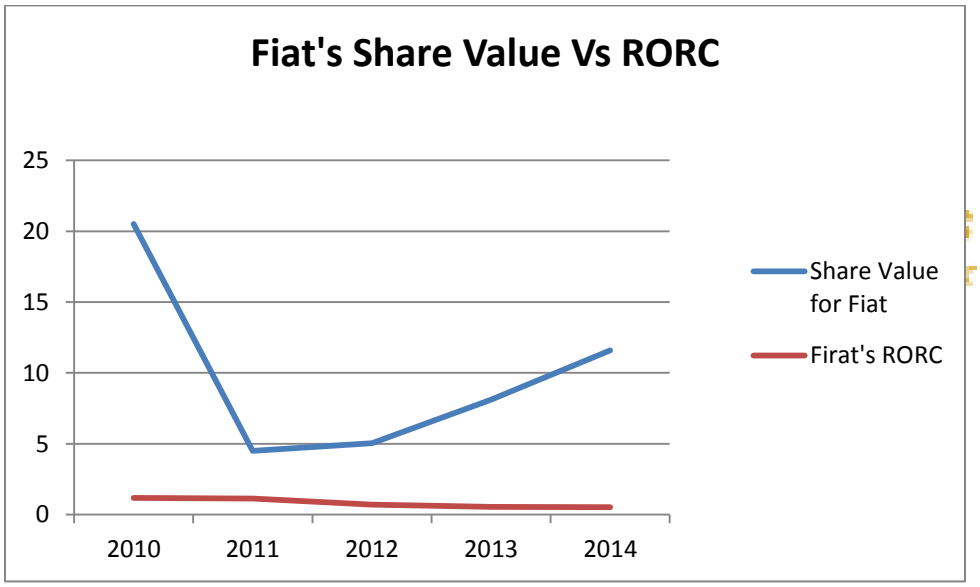


Figure 22: RORC vs Share Value for RORC

Hypothesis Result

Although RORC is the clear answer showing return of investment for research capital, there is no concrete correlation seen between the

share value and RORC. Toyota shows that there is a direct co-relation, but the data from the Fiat does not agree with it completely. It is seen that share value does increase with the increase in the RORC, the clear relation between them cannot be established.

4.7Research Answers as per the Analysis

- *Does R&D expenditure really effect the growth of the company?*

  As evident from the above, research expenditure does affect the revenue, which in turn increases the profit. Since the profitability is in impacted by many other activities, there is no direct relation found between the profit and the research capital, but a direct relation is indeed found between RORC and the revenue.

- *What is the effect of sales each year on R&D spending?*

  AS seen from above graphs, revenue and sales directly follows the change in RORC. This means that R&D spending does influence the sales. Although the change is not proportionate and is delayed, but that is expected as results of R&D takes time. Those results definitely show in revenues earned over the period of time.

- *Does increasing R&D expenditure each year help with the profits?*

As seen in the above cases, the profits are affected by R&D, but it cannot be said that increase in R&D will always have the positive effect on the profits. The strategy of investment in R&D needs to be clearly thought out. Similar consideration needs to be given to the topic of research and developments and the ideas. As Fiat's ex CEO said, it is true not all the ideas will transform in result, but some of them will and will help the sales too. That idea should be kept in mind before finalizing the spending on R&D. If we see the graph we will see that in 2009, the R&D expenditure as a percentage was almost in range for Toyota even after the dip in revenue. This presents a well thought-out strategy. It should be realized that the R&D is dependent on external factors as well and hence should be responsive and adaptable as per those factors.

- *What is the future perspective of R&D spending in the manufacturing industry?*

  Toyota and Fiat, both the companies, believe that research is the backbone of success. Be it the research regarding the sustainable development, or be it the research about the safe driving in case of Fiat, there is the constant need for the investment in R&D. In order to make the cars safer and driving a cleaner experience,

there definitely is the need for innovation, and innovation can only come through the research and development only.

- *Can an effective R&D spend percentage be derived from the research?*

  Although the data is limited to finally present the answer to this question, the above graphs and the table indicate that 3.5-4.2% of the revenue seems like the best bet in terms of R&D expenditure. Toyota's seem to be working in the same range of the R&D expenditure for the whole period of 9 years, while the same even reached till 5% in case of Fiat.

- How effective was the R&D spending in Toyota and Fiat each year?

  The same can be seen from RORC which expresses the rate of return on research capital. As observed, Toyota seems to perform better in terms of RORC as compared to the Fiat.

- What is the different R&D approaches in each company?

  Both the companies truly believe in R&D. While Toyota is known already for its well-developed R&D programme, the study shows that Fiat also has invested continuously in the research and development, although their approach looks more conservative as compared to

the aggressive R&D by the Toyota. Both the companies invested in R&D even during the difficult period of 2009-2010 when the revenues were lowered because of the economic depression.

4.3. Conclusion

As discussed in the literature review, it is difficult to find the direct relationship between the financial performance and R&D investment. But a look at the graphs and the comparison of the two companies clearly indicates that there might not be a direct relation between the two, R&D indeed impacts the performance of the company. Be it the brand value as indicated in the share value of the Toyota or be it the increase in revenue, the investment in R&D does translate into financial success.

But then investment should not be blind investment. There has to be a definitive plan and process for which investment should be carried on. The risk factors should be analyzed properly and customers' need should be kept in the mind for the success of the R&D investment.

Currently Toyota and Fiat both have their R&D divisions globally. This not only helps them with the global knowhow, but also provides them with the mean to customize the products as per the reason. This also brings them closer to the customer and hence there is a better

understanding of their needs. This says a lot about the global R&D centers.

There is no fixed formula for finding the right amount of R&D investment, but the analysis show that the best value lies between 3.5-4.5% of the total revenue. 2.5% seems like a more conservative bet, and beyond 4.5% is more risky as shown from the reducing profits of the Fiat.

Thus care is required in calculating the economies of scale while deciding on the percentage of revenue to be invested in research and development.

Chapter 5: Conclusion

We started our research paper with the following research questions:

1. To compare R&D expenditure to growth factors.
2. To understand the effects of year after year expenditure on R&D on brand value of the companies.
3. To define an effective R&D spend percentage.

In order to analyze these questions, the paper delved deeper into the annual reports of the two manufacturing companies of Fiat Chrysler and Toyota and available literature associated with the subject.

- As the analysis in Chapter 4 clearly indicates that the R&D expenditure indeed affects the growth factors. There might or might not be a direct relationship between the various growth factors and the investment in R&D team, but there is certain growth factor indeed follows the R&D investment. The same has corroborated by the literature review as well where almost all the scholars are of the opinion that R&D is necessary for the success of any of the organization—be it the manufacturing firm or any other service company.

  We also observe that the constant increase in the R&D amount does not always translate to profits equitably.

The literature review suggests that extra dollars in R&D does not mean extra profit. This is clearly indicatedin the year 2009 when both the companies had much lower profit despite the same percentage of investment. The results of R&D are dependent on many factors including internal and external factors. R&D can provide the required push for the necessary profit, but it cannot change the pathwork laid by the external factors. It also calls for constant support of the internal factors to translate the results of R&D into financial results.

- The second part of the objective focused on brand value and innovation. For the purpose of measuring the brand value, the RORC and the share values are considered as the parameters. The analysis did not show any direct relation between the share value and the expenditure in R&D. Although there seems to be some change in the share value due to this expenditure, the relation between the share value and the R&D expenditure could not be fully established. But as the literature review suggests, R&D is a slow process. It takes time for the R&D research to translate on the paper, and probably that is the reason that R&D decision alone did not change the investors' perception much.

- Finally the analysis chapter expressed the R&D expenditure as a percentage of revenue and compared the profit data of the two companies which showed that R&D expenditure does influence the profit, but there is no direct relation between the two. Profitability is governed by many other factors as well and R&D expenditure is just one contributing factor.

With the help of the analysis section, it can be clearly concluded that R&D plays an important role in an organization, without which it will be difficult for the organizations to thrive and develop. The R&D expenditure, if used thoughtfully, can bring out the financial growth of the company by increasing the sales and revenue.

The research has been only limited to two manufacturing companies and that too only in the auto industry. For future research, the same can be extended to the companies which have data available for past dates as well. The research can also be expanded into the other sections of the manufacturing industries to truly analyze the result of the investment like pharmaceuticals or FMCG. While the Pharmaceutical companies involve the research that gives results after years, FMCG's ongoing research gives quicker result. Expanding the research in two different areas will give an idea how the research expenditure get translated into the returns.

In short, the research conclude that R&D plays an important role, but its effect can be further studied with wider sample of companies or even the different industries as well.

Appendix 1

Table 4: Toyota's Financial Performance for 2009-2015 including the R&D investment

S.No.	Year	Toyota's Investment in R & D (in Billion Yen)	Revenue in billions of Yen	Operating Income in billions of Yen	Share Value in Yen	Return on Research Capital= Current Year Profit/ Previous Year Expenditure
1	2006	812.6	21,036.91	1,878.34	6430	-
2	2007	890.7	23,948.09	2,238.68	7550	2.75
3	2008	958.8	26,289.24	2,270.38	4970	2.55
4	2009	904	20,529.57	-461.01	3120	-0.48
5	2010	725.3	18,950.97	147.52	3745	0.16
6	2011	730.3	18,993.69	468.28	3350	0.65
7	2012	779.8	18,583.65	355.63	3570	0.49
8	2013	807.4	22,064.19	1,320.89	4860	1.69
9	2014	910.5	25,691.91	2,292.11	5826	2.84

Appendix 2

Table 5: Fiat's Financial Performance Vis-a-vis R&D expenditure

Year	Fiat's Investment in R&D (In Million Euros)	Revenue in dollars in Millions Euros	Profit Before Cash Flow in Million Euros	Share Value in dollars	Current Year Gross Profit/Previous Year R&D expenditure (RORC Calculation)
2006	1591	51832	1641	-	
2007	1741	58529	3152	-	1.98
2008	1986	59564	2972	-	1.71
2009	1692	50102	359	-	0.18
2010	1936	56528	2009	20.5	1.19
2011	2175	59559	2185	4.51	1.13
2012	1858	83765	1524	5.05	0.70
2013	2236	86624	1015	8.12	0.55
2014	2537	96090	1176	11.58	0.53

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