

EMPIRICAL CALCULATION OF ASSET VALUE COMING FROM RESEARCH AND DEVELOPMENT EXPENSES: CASE OF FRENCH RESEARCH, DEVELOPMENT, TESTING SERVICES COMPANIES

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The purpose of our study is to examine the utilization of R&D expenses in knowledge-intensive French companies in the manner of development of future assets recognized and accepted by the current national accounting framework. We included 41 French research, development, testing services companies in a empirical calculation of research asset value. The financial information was obtained from the financial database „Point Risk“ for the purpose of addressing the main research question. The model used in this study is the Research Asset Value Calculation developed by Damodaran (2009). This model investigates the process of capitalization of R&D expenses within French companies. French research, development, testing services companies capitalize its R&D expenses into concrete assets. The main contribution of our research is the examination of the R&D expenses and its recognition as a final performance. This study presents the first confirmation of capitalization of R&D expenses within company's value.

Key words: R&D expenditures, capitalization process, research asset, value creation.

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1. Introduction

The transition of economy from industrial to knowledge-based has changed dramatically the whole accounting, economic and stock market valuation procedure. The accounting treatment of research and development (R&D) has been controversial since a longtime taking into account that managers can be motivated to manage these expenditures in order to gain

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earnings (Triki-Damak and Halioui, 2013). Penman and May (2009) claim that the success of the best companies lays in its knowledge assets.

It is proved that investment in R&D is seen as an important form of investment in high-technology (Karl-Heinz, 2005). Most studies proved that R&D positively influence productivity, profits, sales and employment growth of a company (Lentjushenkova and Lapina, 2014). Both R&D expenses and marketing expenses play a significantly important role in business performance nowadays (Chen, Cheng, and Hwang, 2005a). Lev and Sougiannis (1996) used a sample of 1975-1991 US public companies and proved a significant relationship between company's R&D capital and subsequent stock returns. Chauvin and Hirschey (1993) also found that advertising and R&D expenditures have large and positive effects on corporate market value. This indicates higher future cash flows for companies with greater R&D and advertising expenses. Maggina (2011) stated that one company makes decisions at least one year before investing in R&D and the forecast is around 90% adequate when using a logit specification.

The aim of this study is to make an empirical investigation of effects of capitalization of R&D expenses on the company's total book value by implementing the model of Damodaran (2009).

The analysis is composed of 41 French Research, Development and Testing Services companies over the period from 2012 to 2016. In the research paper, the calculation of research asset value analysis will be examined.

The paper is organized as follows. Section 2 develops literature review related to existing literature and the most prominent authors from the topic. Section 3 explains developed research methodology. Section 4 presents empirical findings, whereas Section 5 concludes the paper.

2. Literature review

R&D activity differs from other types of activities by its nature and by other attributes, such as company's specificity, information asymmetry and high level of uncertainty and risk (Holmstrom, 1989). R&D costs are not intangible assets (Krstić, Vukadinović, 2004). R&D expenses often result in the development of patents or copyrights (product, process, idea, formula etc.) (Warfield, Weygandt, and Kieso, 2008). Research activities are planned search or critical investigation focused on the discovery of new knowledge, whereas development activities are translation research findings into a concrete plan or design for a new product or process (Warfield, Weygandt, and Kieso, 2008).

According to the definition of Frascati Manual (OECD, 1994), research and development includes creative work with a systematic basis aimed at increasing the stock of knowledge. The three main activities are covered:

- 1) *Basic research*: theoretical and experimental work with a purpose to acquire new knowledge about observable facts;
- 2) *Applied research*: original investigation focused on realizing a specific aim or objective in order to acquire new knowledge;
- 3) *Experimental development*: systematic research based on existing knowledge focused on producing new products, materials, services, systems and processes.

Table 1. Types of expenditures and accounting treatments of R&D expenses

<i>Type of Expenditure</i>	<i>Accounting Treatment</i>
Construction of long-range research facility for the use on current or future project.	Capitalize and depreciate as R&D expense
Acquisition of R&D equipment for the use on current project only.	Expense recorded immediately as R&D.
Acquisition of machinery to be used on current and future R&D projects.	Capitalize and depreciate as R&D expense.
Purchase of materials to be used on current and future R&D projects.	Expense recorded immediately as R&D.
Salaries of research staff.	Expense recorded immediately as R&D.
Research costs incurred under contractual obligation.	Record as a receivable.
Material, labor and costs of prototypes.	Expense recorded immediately as R&D.
Costs of testing prototype and design modifications.	Expense recorded immediately as R&D.
Legal fees to obtain new patent.	Capitalize as a patent and amortize.
Executive salaries.	Expense as operating expense.
Costs of marketing research.	Expense as operating expense.
Engineering costs incurred to advance the new research equipment.	Expense recorded immediately as R&D.
Costs of successfully defending a patent.	Capitalize as a patent and amortize.
Commission to sales staff marketing.	Expense as operating expense.

Source: Warfield et al. (2008)

There is a general consensus about the investment in R&D because the results of this investment are related to generating new knowledge and applications that will serve on a long-term basis (*OECD 1989*).

Based on the book published by Warfield et al. (2008), there are 14 different R&D costs with the accounting treatment presented in the Table 1.

Chang and Hsieh (2011) tested the relationship between R&D investment and operating, financial and market performance of a company. The association between these variables showed and proved a positively significant impact. This was a proof that an R&D investment is used as a source of “value creation” based on the Taiwanese example (Chang and Hsieh, 2011).

Investments in R&D have three main arguments (RICARDIS project, 2006):

- Investments in Intellectual Capital (including R&D) are important components of those resources owned by the company;
- The success of investment in R&D depends on the interaction with other intangible resources or intellectual capital components, and those are: Information and organizational capital, marketing and distribution capital, and relational capital;
- The companies' managements are interested in creating immediate value, as well as in the intangible resources that can be derived from the interaction with other resources.

Megna and Klock (1993) stated that an investment in R&D is directly related to the number of patents, or, to be more precise, directly related to increasing a company's book value. Lev (2004) mentioned the investment in R&D of the textile company DuPont in the period from 1985 to 2000. The investment has influence on two thirds of the increase in the value generated within a company.

Taking into consideration all advantages and benefits of investments in R&D, there are also limitations grouped in four areas (*European Commission, 2003*):

- a. *Financial Resources* – There are many reasons why it is difficult to raise money from banks, financial institutions or investors to prove a suitable business proposition. This is because the investments in research and development are highly risky and it is very often difficult to predict the final result. Raising money is a much more difficult task for start-up companies than it is for large corporations that will easily find a way to generate profits;
- b. *Knowledge* – A combination of external and internal knowledge is necessary when introducing new innovations onto the market. In order to be innovative,

it is highly important to take a broader knowledge base than the one from the past. External and internal knowledge sources must be managed properly;

c. *Human Capital* – Skilled and talented people are a very important element in the whole research and development process. Developing and managing human capital is a highly important part for successful, highly innovative companies. Michie (1999) thinks that the skill-shortage is a serious obstacle in the research process.

d. *Management Competences* – The lack of management competences in the part of marketing, organization and innovation is another key reason why companies do not invest more in R&D. The lack of management competences makes it difficult to plan and implement R&D in a successful manner.

R&D expenses recognition and capitalization possibilities by accounting standards

If a company wants to have a recognized and capitalized developed intangible asset, it must have substantial research and development expenses accepted by International Accounting Standard (IAS) 38 to create an intangible. Based on the IAS 38 in the development phase, there are six main conditions that should be met if a company wants to capitalize and include an intangible asset inside the balance sheet (IAS Standard 38 - Intangible Assets, 2001):

- Technical feasibility of building intangible assets, so that it will be ready for usage or sales;
- Intention to build intangible assets for usage or sales;
- Ability to use or sell intangible assets;
- Possibility to generate future economic benefits based on the existence of market demand;
- Availability of adequate technical, financial and other resources to complete the development of intangible assets;
- Ability to precisely measure all expenditures attributable to that intangible asset.

Based on the IAS 16 Property, Plant and Equipment (PPE), there are two main criteria for recognition and capitalization of tangible assets within the balance sheet. The focus here is only on the tangible assets:

- I) Future economic benefits will probably be associated with the item used;
- II) Historical costs will probably be measured reliably.

According to the Statement of Financial Accounting Standards No.2 – Accounting for R&D costs in the United States, all R&D expenses must be expensed. Expensing means that all annual R&D expenses must be subtracted

from the annual revenues (sales) in the process of net income calculation. The main characteristics of immediate expensing is that there are no future benefits. Immediate expensing alternative is capitalization – recognition process of R&D expenses as an asset in the balance sheet. The impact of capitalization of R&D has two sides: one is when R&D expenses are capitalized as an asset in the balance sheet, and the other is when that asset must be amortized. The amortization amount is also expense that appears in the profit and loss account (Deng and Lev, 2006). On average, investors make a decision to capitalize and amortize R&D expenses, rather than to expense (Deng and Lev, 2006).

According to the paper of Ding et al. (2004), the capitalization process of R&D expenses is possible in France, but under certain conditions. This study proved that the capitalization of R&D is a risky process, in the sense that they belong to the group of high technology industries, or have higher beta coefficient, which is related to tax of rentability on the market. Triki-Damak and Halioui (2013) explained that in the French setting, it is up to the management to decide whether to expense or capitalize. If the conditions from the IAS 38 are met, then the capitalization process is certain. The only difference between IFRS/IAS and GAAP is the obligation to capitalize R&D expenses. GAAP does not accept the capitalization of R&D expenses, whereas IFRS/IAS allows it under certain conditions.

Based on the French evidence, Cazavan-Jeny et al. (2011) established that, after controlling the industry effect, companies that make decisions to capitalize R&D expenditures spend less on R&D, have much more volatile R&D efforts, are smaller and more leveraged than companies that expense their R&D expenditures. The decision to capitalize R&D expenses influences a company's financial statements, such as balance sheet, income statement, cash flow and all related ratios, not only in the current business year, but also in the future accounting periods. Zhao (2002) established that the value relevance of R&D expenses in France, Germany, USA and UK from 1990 to 1999 confirmed that the reported R&D expenses increased the overall value relevance. The decision to capitalize R&D may increase value for all financial statements users (Aboody and Lev, 1998; Healy et al., 2002; Lev and Sougiannis, 1996).

Nelson et al. (2003) estimated that management decision whether to capitalize or expense is linked to a company's earning management strategies. When a company has lower operating profitability in a certain year, capitalization process will commence. On the other side, when the year is more profitable, the company will then decide to expense their R&D expenditures.

Nixon (1997) argued that proponents of immediate expensing of R&D explain that a capitalization process eliminates the choice to capitalize costs of projects with much lower probability of success. Furthermore, the same author presented three main reasons why some managers are against the capitalization process:

- a. it increases chances to manipulate reported numbers;
- b. it is a subjective judgment decision;
- c. it is consistent with shortening the life-cycle of a product.

Several studies proved that expensing R&D expenses motivate managers to underinvest in R&D to meet their performance goals (Baber et al., 1991; Bushee, 1998; Cooper and Selto, 1991). On the other side, the study by Seybert (2010) proved that managers who initiate an R&D project very often overinvest when R&D expenses are capitalized. If an R&D project leads to overinvestment, then the decision whether to capitalize and expense will result in a similar decline in earning management.

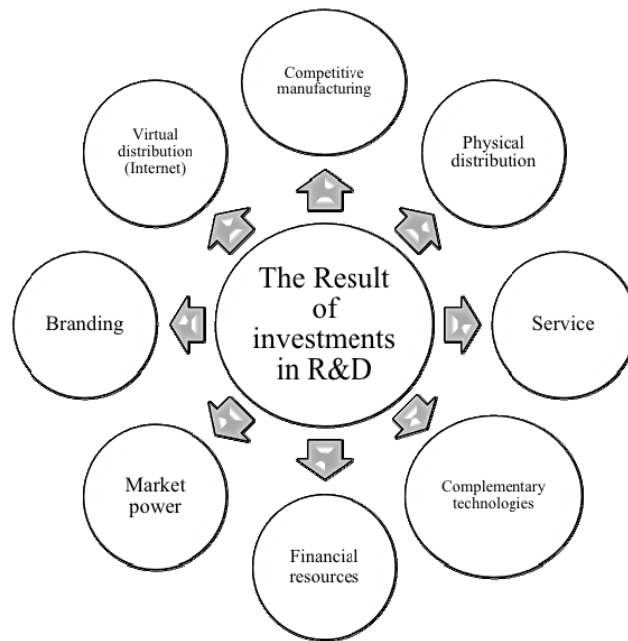
R&D expenses potential outcomes

Teece (2002) thinks that investments in R&D alone are not sufficient. To be successful, investments in R&D must produce a complementary asset that will be packed into products or services to yield value. He distinguished three types of complementary assets:

- *Generic Assets* need to be tailored according to the innovation, such as generalized equipment and skills;
- *Specialized Assets* with unilateral dependence, such as marketing and distribution channels;
- *Co-Specialized Assets* with bilateral dependence, such as repair facilities and machines.

The Figure 1 above presents potential and possible complementary assets that can be produced, capitalized and developed when investing in R&D. There are eight potential types of complementary assets and those are: competitive manufacturing, physical distribution, service, complementary technologies, financial resources, market power, branding and virtual distribution (adapted from Teece, 2002).

Figure 1. Possible complementary assets produced from the investments in R&D



Source: Teece, 2002.

3. Research Methodology and Hypothesis

The main research question will be: “Do the French high technology companies capitalize its R&D expenses, and in which amount?” The research hypothesis will prove that there is a capitalization process and recognition of value in the sample of French R&D intensive companies in the observed period of 2012 to 2016.

The research methodology of our study will be based on the model of calculation of research asset value developed by Damodaran (2006, 2009).

Damodaran (2009) explored the importance of R&D expenses for the success of a company. He thinks that all expenses focused on providing benefits over multiple periods must be seen as capital expenses, and these expenses are depreciated over a certain period of time. Damodaran argues that R&D expenses must be capitalized expenses, and not operating expenses because they bring long-term benefits, such as cash flow and growth in

valuation. For instance, operating costs are expenses that provide benefits only for the current period. The cost of labor and materials belong to the group of operating costs. Operating expenses do not create any asset and do not influence a company's capital. They do so only through indirect influence on retained earnings. On the other side, capital expenses are expenses that will last for a longer period, but they bring and generate benefits over multiple periods. The cost of purchasing a land or buildings belongs to the group of capital expenses. Capital expenses can create an asset and affect a company's capital. Taking into account everything previously mentioned, investments in land, plant, research and development, training, software, marketing must be treated as capital expenses.

The core of our interest is the capitalization and recognition of these capital expenses inside the balance sheet of a company that will generate benefits for the future. The main question is related to the results and effects of an investment in research and development. In order to capitalized R&D expenses, it is necessary to accumulate all R&D expenses and to create a *research asset*. A company's equity and assets increase together with the development of the research asset. The number of years necessary to develop one research asset depends on the industry that a company belongs to. This period of development of a research asset is called useful life.

The following formula presents the value of the research asset calculation given by Damodaran (2009):

$$\text{Value of the Research Asset} = \sum_{t=0}^{t=n} R\&D_t \frac{(n+1)}{n}$$

Damodaran (2009) gave an example of calculation of a research asset on Boeing over the last 10 years (Table 2).

Damodaran (2009) further explored and found that the capitalized value of R&D is seen as the value of a research asset. Now, the recognized research asset will directly increase the value of a company's equity and book value of asset up to \$8,587. At the same time, a research asset increases a company's operating income because what remains after the capitalization of R&D expenses is only the amortization of a research asset. There will no longer be R&D expenses with that character. R&D expenses are usually higher than amortization of a research asset and that is why a company's operating income increases after the capitalization of R&D expenses.

Table 2. Table of calculation of research asset

<i>Year</i>	<i>R&D</i>	<i>Unamortized Portion</i>	<i>Unamortized Value</i>
1988	\$ 751	0.10	\$ 75
1989	\$ 754	0.20	\$ 151
1990	\$ 827	0.30	\$ 248
1991	\$ 1,417	0.40	\$ 567
1992	\$ 1,846	0.50	\$ 923
1993	\$ 1,661	0.60	\$ 997
1994	\$ 1,704	0.70	\$ 1,193
1995	\$ 1,300	0.80	\$ 1,040
1996	\$ 1,633	0.90	\$ 1,470
1997	\$ 1,924	1.00	\$ 1,924
Capitalized Value of R&D Expenses			\$ 8,587

Source: Damodaran, 2009.

4. Methodology - data selection

Our sample is composed of 41 French Research, Development, Testing services companies in the period of 2012 to 2016. The financial information were obtained from the French financial database “Point Risk”. Our goal is predict and examine the capitalized value coming from the R&D expenses in a particular period of time.

Based on the study by Helmer et al, (2016) the observed number of years was 5 because that is defined period of time necessary for development of research asset for the Research, Development, Testing services industry in France. I used this useful life of assets to link each company to the industry they belong to in order to see how many years it is necessary to follow financial information from the database. Classification of Industries that will be used is developed by Francis and Schipper (1999).

5. Research Results and Discussion

In this section, we follow R&D expenses for the period of 5 years, and examine how much of the value will be developed within companies assets.

Table 3. R&D expenses of 41 French companies over time 2012-2016

Serial Number	R&D Year 1 (2012)	R&D Year 2 (2013)	R&D Year 3 (2014)	R&D Year 4 (2015)	R&D Year 5 (2016)
1	€ 11,637,000	€ 11,782,000	€ 15,080,000	€ 18,239,000	€ 24,218,000
2	€ 76,000	€ 76,000	€ 76,000	€ 76,000	€ 31,000
3	€ 1,140,000	€ 1,642,000	€ 1,853,000	€ 1,715,000	€ 1,561,000
4	€ 1,467,000	€ 1,790,000	€ 1,872,000	€ 2,080,000	€ 2,109,000
5	€ 143,000	€ 242,000	€ 326,000	€ 374,000	€ 402,000
6	€ 88,000	€ 88,000	€ 88,000	€ 178,000	€ 178,000
7	€ 29,000	€ 29,000	€ 29,000	€ 29,000	€ 29,000
8	€ 42,000	€ 58,000	€ 78,000	€ 83,000	€ 89,000
9	€ 529,000	€ 545,000	€ 1,041,000	€ 1,324,000	€ 1,580,000
10	€ 30,000	€ 30,000	€ 48,000	€ 98,000	€ 113,000
11	€ 3,309,000	€ 4,313,000	€ 6,182,000	€ 8,686,000	€ 11,474,000
12	€ 977,000	€ 1,077,000	€ 1,380,000	€ 1,394,000	€ 1,604,000
13	€ 4,659,000	€ 2,705,000	€ 794,000	€ 1,011,000	€ 1,282,000
14	€ 1,764,000	€ 2,613,000	€ 3,175,000	€ 2,490,000	€ 2,439,000
15	€ 71,000	€ 88,000	€ 88,000	€ 88,000	€ 88,000
16	€ 1,844,000	€ 2,270,000	€ 2,810,000	€ 3,266,000	€ 3,559,000
17	€ 1,185,000	€ 1,185,000	€ 1,185,000	€ 1,185,000	€ 1,203,000
18	€ 5,125,000	€ 5,409,000	€ 5,549,000	€ 6,345,000	€ 6,855,000
19	€ 88,000	€ 88,000	€ 97,000	€ 97,000	€ 44,000
20	€ 312,000	€ 312,000	€ 312,000	€ 3,986,000	€ 3,986,000
21	€ 509,000	€ 509,000	€ 495,000	€ 495,000	€ 495,000
22	€ 202,000	€ 214,000	€ 226,000	€ 246,000	€ 273,000
23	€ 1,430,000	€ 2,056,000	€ 2,732,000	€ 2,993,000	€ 2,993,000
24	€ 189,000	€ 210,000	€ 251,000	€ 270,000	€ 270,000
25	€ 13,000	€ 13,000	€ 46,000	€ 46,000	€ 66,000
26	€ 83,000	€ 83,000	€ 93,000	€ 100,000	€ 118,000
27	€ 73,000	€ 99,000	€ 87,000	€ 105,000	€ 105,000
28	€ 778,000	€ 786,000	€ 1,115,000	€ 1,066,000	€ 1,199,000
29	€ 341,000	€ 119,000	€ 242,000	€ 496,000	€ 530,000
30	€ 189,000	€ 239,000	€ 277,000	€ 302,000	€ 334,000
31	€ 1,041,000	€ 1,231,000	€ 1,433,000	€ 1,231,000	€ 1,562,000
32	€ 1,156,000	€ 2,376,000	€ 3,442,000	€ 4,056,000	€ 13,365,000
33	€ 2,378,000	€ 2,630,000	€ 2,630,000	€ 2,597,000	€ 2,550,000
34	€ 2,046,000	€ 2,185,000	€ 2,526,000	€ 2,614,000	€ 3,187,000
35	€ 1,903,000	€ 1,903,000	€ 1,903,000	€ 1,813,000	€ 1,813,000
36	€ 3,543,000	€ 4,829,000	€ 5,768,000	€ 6,995,000	€ 8,459,000
37	€ 4,063,000	€ 4,350,000	€ 5,028,000	€ 5,623,000	€ 6,051,000
38	€ 31,000	€ 31,000	€ 31,000	€ 31,000	€ 37,000
39	€ 1,486,000	€ 1,788,000	€ 2,086,000	€ 2,216,000	€ 2,467,000
40	€ 439,000	€ 439,000	€ 439,000	€ 465,000	€ 504,000
41	€ 54,000	€ 54,000	€ 54,000	€ 72,000	€ 70,000

Source: Authors' calculation

The Table 3 above presents R&D expenses for the selected 41 French companies over the period of 2012 to 2016. In the sample are observed all available companies, and its financial information, without further grouping

based on its size. As we can see, the expenditures on R&D differ from year to year, and from company to company.

Table 4. Research Asset Value

Serial Number	AVERAGE OF ALL R&D EXPENSES	TOTAL R&D EXPENSES	Research Asset Value
1	€16,191,200	€80,956,000	€64,764,800
2	€67,000	€335,000	€268,000
3	€1,582,200	€7,911,000	€6,328,800
4	€1,863,600	€9,318,000	€7,454,400
5	€297,400	€1,487,000	€1,189,600
6	€124,000	€620,000	€496,000
7	€29,000	€145,000	€116,000
8	€70,000	€350,000	€280,000
9	€1,003,800	€5,019,000	€4,015,200
10	€63,800	€319,000	€255,200
11	€6,792,800	€33,964,000	€27,171,200
12	€1,286,400	€6,432,000	€5,145,600
13	€2,090,200	€10,451,000	€8,360,800
14	€2,496,200	€12,481,000	€9,984,800
15	€84,600	€423,000	€338,400
16	€2,749,800	€13,749,000	€10,999,200
17	€1,188,600	€5,943,000	€4,754,400
18	€5,856,600	€29,283,000	€23,426,400
19	€82,800	€414,000	€331,200
20	€1,781,600	€8,908,000	€7,126,400
21	€500,600	€2,503,000	€2,002,400
22	€232,200	€1,161,000	€928,800
23	€2,440,800	€12,204,000	€9,763,200
24	€238,000	€1,190,000	€952,000
25	€36,800	€184,000	€147,200
26	€95,400	€477,000	€381,600
27	€93,800	€469,000	€375,200
28	€988,800	€4,944,000	€3,955,200
29	€345,600	€1,728,000	€1,382,400
30	€268,200	€1,341,000	€1,072,800
31	€1,299,600	€6,498,000	€5,198,400
32	€4,879,000	€24,395,000	€19,516,000
33	€2,557,000	€12,785,000	€10,228,000
34	€2,511,600	€12,558,000	€10,046,400
35	€1,867,000	€9,335,000	€7,468,000
36	€5,918,800	€29,594,000	€23,675,200
37	€5,023,000	€25,115,000	€20,092,000
38	€32,200	€161,000	€128,800
39	€2,008,600	€10,043,000	€8,034,400
40	€457,200	€2,286,000	€1,828,800
41	€60,800	€304,000	€243,200

Source: Authors' calculation

The Table 4 above presents average and total expenditures on R&D of the observed sample of French companies. In the final column are presented the Research Asset Value coming from R&D expenses. Overall empirical results prove our research hypothesis and clearly indicate that there is a capitalization process. The amount of capitalization directly depends on the annual expenditures on R&D.

5. Conclusion

This study examined whether R&D expenses create assets value by capitalizing within company's total value. We use French high-technology companies from the Research, Development, Testing services industry to investigate this issue. In France, companies may capitalize R&D expenses taking into consideration that France applies IAS/IFRS standards adopted in 2005. We find that French companies capitalize development costs associated with R&D expenses in the period of 5 years.

Our results suggest that after recognition and capitalization of R&D expenses, assets developed within a company will generate benefits on a long-term, compare to the short-term financial performance, such as profits, sales, market shares, etc. These results can stimulate managers to take risk and make decision to capitalize these expenses in order to focus on achievements of long-term goals.

Future research may extend our study on other industries and other countries, but also and determining the precise assets developed from these R&D expenses. Moreover, the question will be what precisely was developed within company's total book value of assets, tangible or intangible asset. This perspective is interesting and requires further examination.

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