

CHANGING R&D PROSPECTS IN METAL COMPANIES

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Abstract

Managers of metal companies recognize the importance of continuous product development and engineering. Value chain integration, product platforms, digital business models and marketing are still less noticeable in metal companies but that may change fast as customers adopt new concepts. Managers have to respond to those changes with strategic initiatives, which are difficult to measure and control. I analyze changes in research and development expenditures focusing on industrial metals and mining companies. The decision to increase or decrease R&D expenditures in relation to changes in sales is strategic in metal companies as unprecedented stream of innovative products enter the market. In this paper, I propose to distinguish four basic management behaviors related to R&D expenditures and provide with graphical exemplification of market analysis based on two variables (growth in R&D expenditures and growth in sales). The results indicate differences in behavior of companies in developed and developing countries. Further differences can be observed between lower R&D intensity and higher R&D intensity companies. The proposed methodology can be used to map the company's R&D competitive position.

Keywords: R&D, corporations, metallurgy, innovation

1. INTRODUCTION

Innovation is without doubt the key to competitive advantage in young industries but mature, commodity based industries also experience accelerated changes. In industrial metals and mining companies, innovations result from:

- own or industry R&D initiatives,
- clients' R&D efforts and
- digitalization of value chain processes.

R&D initiatives are part of business strategy. A strategy is a set of coherent, mutually reinforcing policies or behaviors aimed at achieving a specific competitive goal. Companies define their overall business strategy and specify how various functions - such as marketing, operations, finance and R&D will support it. Some companies adopt a dedicated innovation strategy [1]. In metal companies R&D activity is viewed as behavior or a policy supporting innovation [2,3].

World Steel Association estimates that 75% of the steels used today did not exist 20 years ago. While it is difficult to show direct relation between R&D expenditures and innovation [4] it is usually assumed that R&D is an important driver of innovativeness, especially in capital intensive industries such as basic metals and fabricated metal products. Recent innovations in this industry include lighter and stronger alloys used in phones, computers and cars. According to a recent study conducted by PwC 47% of metal companies see innovation as "competitive necessity" [5].

2. METHODOLOGICAL BASIS

This paper is based on prior research of R&D in metallurgical companies by Filipou and King [6], Vitsenets [7] and Pomykalski [2]. The findings are also relevant to knowledge management in metallurgical companies researched by Vilamova et al. [8].

Measuring R&D efforts and effectiveness is challenging and subject to debate both in academic and business circles [9]. In this paper, I analyze the relation between growth in R&D expenditures and growth in sales. I also use the R&D intensity ratio (which describes the relation of R&D expenditures to sales).

Some companies choose to incorporate R&D into its strategy or implement a policy. In most obvious case, R&D expenditures will increase with growing sales. R&D intensity (the ratio of R&D expenditures in relation to sales) will stable. In second case R&D expenditures will increase even when sales will decrease. Companies in this group execute policies or strategies assuming growing R&D involvement. In a third group of companies, R&D expenditures will decrease as a result of decreasing sales. Managers will react to dropping sales by decreasing expenditures. Managers of companies in this group either assume that R&D expenditures should be cut when revenues fall or are forced to do that as company's financial standing deteriorates. In the fourth scenario R&D expenditures fall while sales increase. This behavior can be explained by major differences between planned and actual results (sales grow at a higher rate than anticipated) or may occur as a result of mergers and acquisitions.

In this paper, I assume that corporate R&D expenditures should be addressed on individual basis rather than by measures of central tendency of R&D intensity. I present the graphical results of analysis of 3-year growth in R&D expenditures and sales of top R&D basic metals and fabricated metal products companies.

3. R&D EXPENDITURES - GLOBAL PERSPECTIVE

Analysis of changes in basic metals and fabricated metal products requires some introduction to changes in global markets which have a profound impact on financial results of companies operating in different parts of the globe.

The World Steel Association estimates that China accounts for 45% of global steel demand. Although demand is expected to remain flat or even decline in the forthcoming years major changes in structure of demand are unlikely. Results of PwC survey indicate that collaboration with customers in developing innovations is top priority for metal companies [5].

Research and Development (R&D) expenditures in basic metals and fabricated metal products changed significantly during the last 15 years. China's share of global R&D expenditures grew rapidly from 19% in 2000 to 70% in 2013.

Table 1 R&D expenditures in basic metals and fabricated metal products except machinery and equipment (in millions of 2010 US dollars - constant prices and PPPs)

	2010	2011	2012	2013	2014
China	19 227	22 755	29 656	31 083	32 409
Japan	2 649	2 810	2 554	2 578	2 794
United States	2 356	2 457	2 476	2 685	NA
Germany	1 515	1 544	1 585	1 527	NA
Korea	972	1 348	1 429	1 342	1 321
France	877	1 046	1 067	1 074	NA
United Kingdom	932	905	779	763	NA
Other countries	3 320	3 990	3 002	3 828	NA
Total (OECD statistics)	31 847	36 855	42 549	44 881	NA

Source: OECD Data

According to China Statistical Office 246.137 people were full time employed as personnel in R&D in manufacture of metal products, smelting and pressing of non-ferrous metals and smelting and pressing of ferrous metals (**Figure 1**). In 2015 alone, 46.234 patent applications were filled by Chinese researchers.

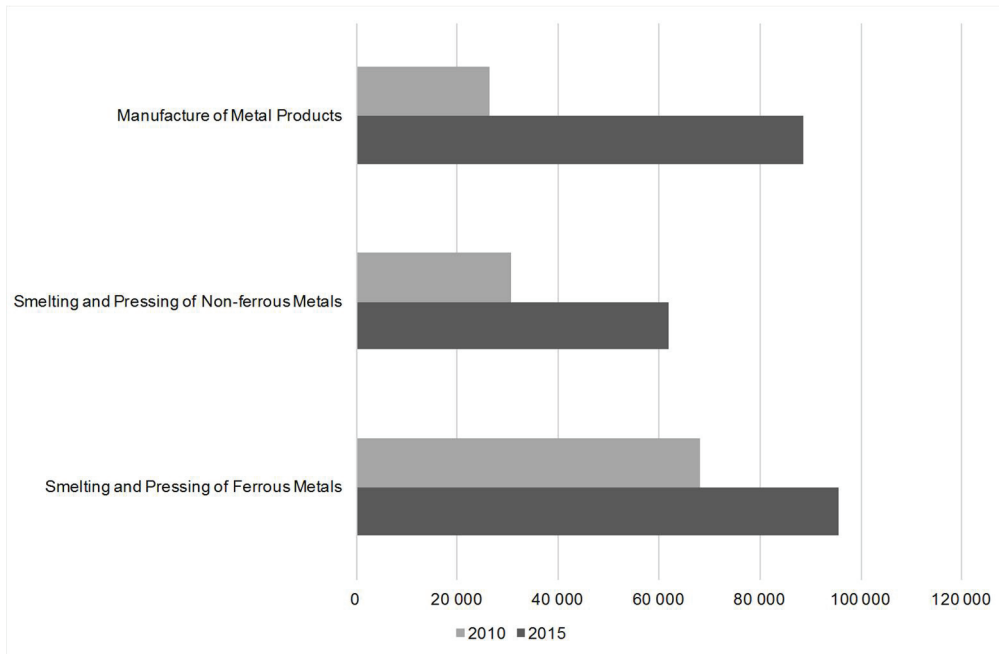


Figure 1 Full-time equivalent of R&D Personnel (man-year)

Data: China Statistical Office

After more than ten years of unmatched expenditures China created research infrastructure and human capital to assume a leading position in basic metals and fabricated metal products R&D.

In another survey of metal industry companies PwC provided for insights into another important trend. Metal companies are preparing to invest as much as 4% of their annual revenues over the next five years in digital operations, which will change internal value chains and alter cooperation with partners. The introduction of digital operations is forecasted to increase revenues by 2.7% and reduce costs by 3.2% [10]. Both costs and awaited results are considerable [11] taking into consideration the financial results of metallurgical companies [12,13,14].

4. DATA

The data used in this paper is based on the 2016 EU Industrial R&D Investment Scoreboard, which contains economic and financial data for the world’s top 2500 companies ranked by their investments in research and development (R&D). A subset of 37 industrial metals and mining companies has been extracted from the database. The group is fairly diverse with companies spending between 21.6 million euros and 522.1 million euros on R&D.

5. RESULTS

The comparison analysis is possible thanks to:

- comparable accounting data (most companies in this research use the International Financial Reporting Standards),
- computing capabilities
- access to financial annual reports and data

Direct comparison of R&D expenditures and revenues of individual corporations (**Figure 2**) provides for interesting conclusions presented in my earlier work [6] in which I suggest to distinguish between low R&D intensity companies and higher R&D intensity companies in basic metals and fabricated metal products companies.

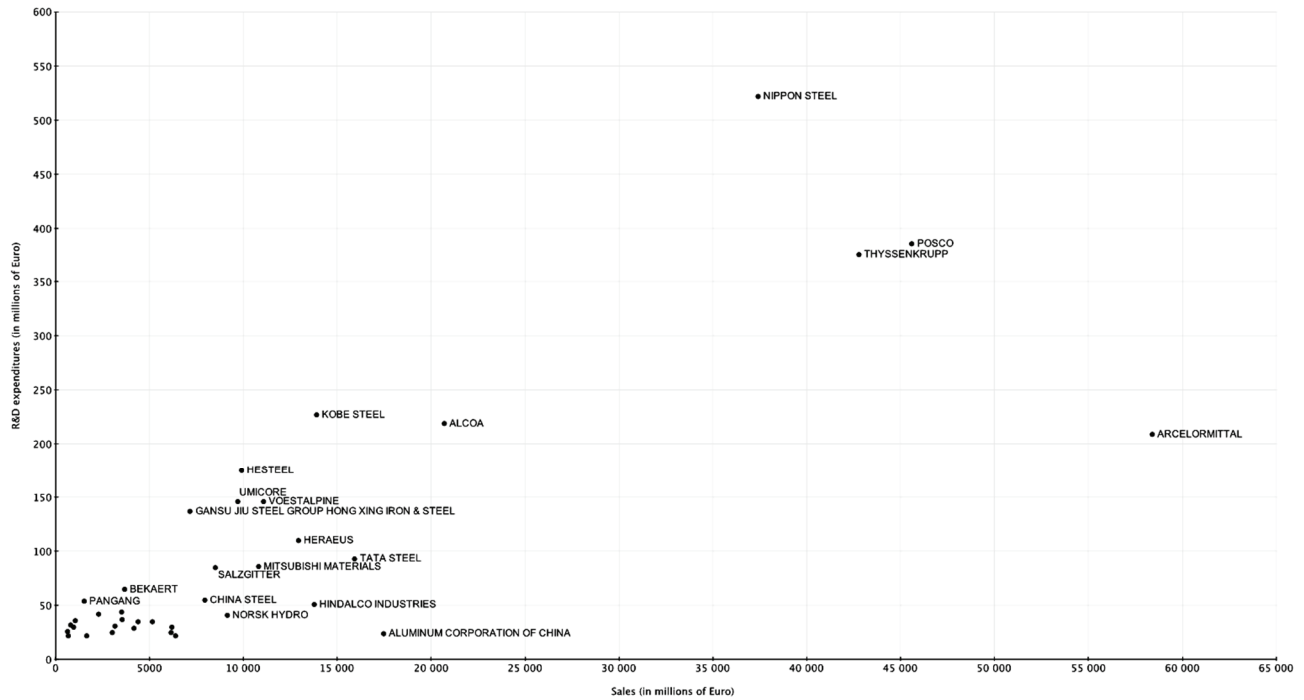


Figure 2 Corporate R&D Expenditures and Revenues in 2015

Source: own, data European Commission, Joint Research Centre

Analysis of changes in R&D expenditures and sales allows for further interesting conclusions. Based on the relationship between the two variables (3-years R&D expenditures growth to 3-years sales growth) four basic types of behaviors can be identified.

- 1) Increasing R&D expenditures with growing sales
- 2) Increasing R&D expenditures with falling sales
- 3) Decreasing R&D expenditures with falling sales
- 4) Decreasing R&D expenditures with growing sales

All four behaviors can be observed in the period 2012-2015 (**Figure 3**). R&D expenditures increased in most (24) companies (**Table 2**). Growth in R&D expenditures with growing sales was observed in 12 companies. It's interesting to note that this group is characterized by comparably low R&D intensity. The companies in this group included Arcelor Mittal, most Chinese producers, two Scandinavian and one American company.

German producers including ThyssenKrupp, Salzgitter and Heraeus, Austrian Voestalpine and American Alcoa exhibit growth in R&D despite decreasing sales (behavior 2). China Steel is an exception in a group formed by producers from developed countries.

Cutting R&D expenditures while sales decrease (behavior 3) allows companies to improve short term operations efficiency (profits). Surprisingly 7 of the 8 companies that decreased R&D while sales decreased were profitable.

Decreasing R&D expenditures with growing sales (behavior 4) comprises 5 companies and - four from developed countries and one from India. It should be noted that average R&D intensity in these companies is almost double that of the first group.

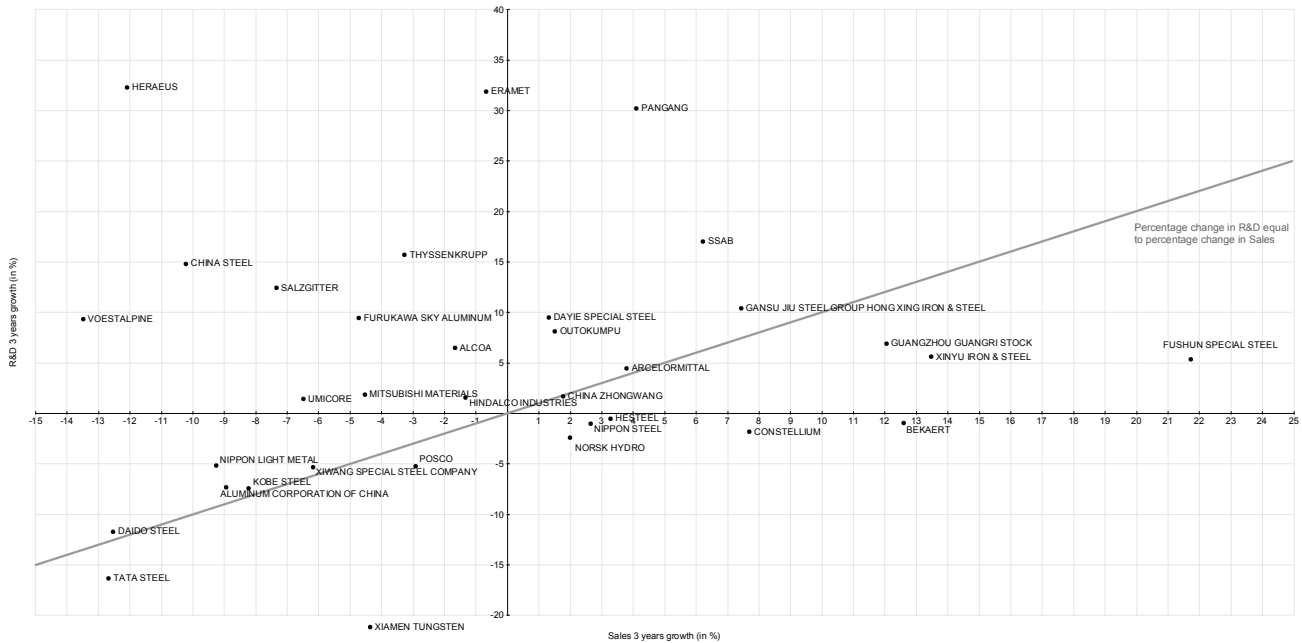


Figure 3 Corporate R&D Expenditures 3-years growth and Revenues 3-years growth in 2015

Source: own, data European Commission, Joint Research Centre

The results indicate that four basic behaviours can be identified in the market and although the grouping may be arbitrary it can lead to interesting conclusions. Companies may use this method in the analysis of their R&D efforts compared to other companies in the market and globally.

Table 2 R&D expenditures, sales and R&D intensity in metal companies

Behavior	Companies	R&D expenditures	Sales	R&D intensity
1	12	659	97 505	0.68%
2	12	1 353	147 251	0.92%
3	8	876	101 913	0.86%
4	5	838	65 275	1.28%

Source: own, data European Commission, Joint Research Centre

In the forthcoming years, R&D expenditures may be impacted by the involvement in digital operations as some companies may opt to decrease own R&D and use open innovation systems based on their newly acquired IT capabilities. Networking effects [15] may become visible. Given the comparably high R&D expenditures in China and comparably low expenditures reported by individual Chinese companies results of R&D initiatives may present themselves as networking effects [16].

CONCLUSIONS

The decision to increase or decrease R&D expenditures in relation to changes in sales is strategic in metal companies as unprecedented stream of innovative products enter the market. In this paper, I proposed to distinguish four basic behaviors related to R&D expenditures and provided with graphical exemplification of market analysis based on two variables (growth in R&D expenditures and growth in sales). The results indicate differences in behavior of companies in developed and developing countries. In developed countries companies will increase R&D expenditures even if sales decrease. Companies from developing countries prefer to decrease their R&D expenditures in such conditions. Few companies decide to decrease R&D

expenditures amid increasing sales. Companies exhibiting this behavior are usually those with comparably higher R&D expenditures compared to sales (R&D intensity ratio).

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