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GOING OPEN WHILE INNOVATING: DOES IT PAY?

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Abstract:
The research investigates into the relationship between the company's innovation inputs and its performance. The research was carried out on the sample of 2500 Slovenian companies from manufacturing and selected service sectors.
The results indicate a correlation between the revenues arising from innovations and the company's performance in terms of the financial ratios, in particularly ROE and growth of revenues from sales. Furthermore, it is shown that the distribution of innovation expenditures is related to the company's innovation performance. The financial inputs related to external sourcing of ideas and knowledge (open innovation) have a positive correlation with the innovation performance.
Key Words: ***Open Innovation, R&D, Productivity, Performance***

1. INTRODUCTION

A positive correlation between the ability to successfully launch new product/service and sustained economic performance has been confirmed in a number of studies. However, business performance is not an outcome due solely to innovation. It is dependent on a wide range of factors. In general, there is clear evidence that innovation play a crucial role to long term profitability and growth in firms [1-6].

What is the background of the effects of innovation to company performance? According to [7] there are two alternative views. The first view holds that the production of new products or processes strengthens a firm's competitive position in relation to its rivals. But the profits and growth will be transitory and only last as long as the innovating firm can defend its position against rivals. The second view argues that the process of innovation transforms a firm fundamentally by enhancing its internal capabilities, making it more flexible and adaptable to market pressures than non-innovating firms [1]. It was shown by [2] that innovating firms are both more profitable and grow faster than non-innovators, but the major difference in performance turns out to be cyclical: innovators profits and growth are much less cyclically sensitive than non-innovators. A recent European Union's study indicates that the EU's most innovative firms may be relatively less affected by the economic crisis [8].

The relation between fluctuations in market value of manufacturing firms and their R&D expenditures has been confirmed by several authors [9],[1]. This relation could be due to shifts in the demand for the output of a firm or due to shifts in new technological opportunity available to the firm [10]. However, the authors show that the changes in patenting rates can account for only a small fraction of the changes in the stock market value of the firm. The pharmaceutical industry is an exception to this since here they find that the technological factor is almost as important as the short-run demand factor in explaining movements in the rate of return.

Both internal and public knowledge make a positive contribution to innovation although public knowledge sources have only an indirect effect on innovation outputs and on creation of proprietary technology. In the exploitation phase, innovation in both products and processes contribute positively to company growth. [3]

A research focusing on the relationship between technological factors (measured by R&D and patents) and economic indicators (productivity and stock market value), has shown that the technological performance of the firm is positively associated to its market value [1]. Similarly a number of studies, using innovation counts [11]; or patent indicators combined with other variables [12] have confirmed that technology and performance are associated. However, the complexity of the relationship between the innovation process and performance complicates the establishment of a causal link between them [13].

Pursuant to the national statistical data [14] only 35.1% of Slovenian companies prove to be innovative, 41.2% of these in the manufacturing sector. What is more, an in-depth analysis evidently shows that the situation regarding innovation in Slovenian small and medium-sized enterprises (SME) is even worse whereat the large companies record approximately 50% more

innovativeness as the medium-sized ones while the small companies even threefold less than the large ones. Apparently, the Slovenian industry needs an innovation push to outrun the group of innovation followers and catch up with the group of innovation leaders. A number of studies have been carried out in this direction, while the open innovation concepts [15],[16] have received a very limited attention. Here, we intend to focus our contribution.

The purpose of this research is to investigate a relationship between the innovation inputs and the company's performance in achieving innovation results, with a focus on the inputs related to external sourcing of ideas and knowledge.

2. METHODOLOGY

The following research questions were set:

1. Is the amount and distribution of innovation expenditures related to the company's innovation performance?
2. Are the revenues arising from innovation related to the company's financial performance?

Pursuant to the official classification, the sample encompassed companies having their registered office in Slovenia, appertaining either to the manufacturing industries or to the selected service industries. The sample encompassed 2503 companies whereat the manufacturing sectors account for 56% and the service sectors 44% of the sample. 65% of the companies are classified as small in terms of employee count, 27% as medium-sized and the remaining 8% as large companies.

Pursuing the standardized methodology [17],[18] the Statistical Office of the Republic of Slovenia regularly collects data on the target industries. The statistical survey providing the core data for our research is the most recent Community Innovation Survey (CIS 2006) which was carried out throughout Europe in 2007. The Slovenian contribution to the CIS 2006 survey includes data for the period from 2004 to 2006 on the enterprises' product (goods or service), organisational and process innovations, innovation activities and expenditures, co-operation in innovation and the effects of innovation. In addition, company's financial data (balance sheet, profit and loss account and some key financial ratios) was collected from the official statistical database on companies (the Agency of the Republic of Slovenia for Public Legal Records and Related Services), while the third statistical database (Statistical Register of Employment (SRDAP)) provided data on the educational structure of employees. The employment data refer to the fiscal year 2006 while the financial data encompass the period between 2003 (a year before the CIS survey) and 2007 (the ensuing year).

The two key variables that represent a measurable output from the innovation process were defined as: RII ("Index of revenues from innovation"), i.e. a relative share of turnover resulting from innovations, and RMI ("Index of revenues from market innovation"), i.e. a ratio of turnover from innovations new to the market to total innovation turnover. A definition of indices is shown in the **Error! Reference source not found.**; both refer to the innovations introduced in the 2004-2006 period.

In the following phase of the research, the companies recording any revenues arising from innovations (RII>0) were divided into 4 groups pursuant to the value of indices RII and RMI. As a limit of division the medians were set, thus ensuring equal representativeness of companies across all 4 groups. The values of medians for the sample of companies with RII>0 ("Innovators in total") are indicated in the **Error! Reference source not found.**. Dividing the RII/RMI matrix in points predefined with both medians, 4 quadrants are obtained. The group of companies which failed to record any revenues arising from innovation in the period observed (RII=0) was defined as the fifth group (group 0).

Thereupon the innovation groups were in pairs compared using nonparametric tests (Mann-Whitney and Kruskal Wallis Tests) so as to establish in which variables the groups significantly differ among themselves. We compared as follows: (i) the relations between the groups' innovation and business results (Chapter 3), (ii) the volume of their investments into innovation (Chapter 4), and (iii) the structure of innovation investments (Chapter 4).

As demonstrated above, the values of the two primary output indices of the invention-innovation process (RII and RMI) served as criteria for grouping the companies. These values are indicated separately for non-innovative (0) and innovative (1 & 2) companies (these are further divided into 4 subgroups 1a, 1b, 1c and 2) in **Error! Reference source not found.**.

We aimed at identifying a relationship between RII and RMI. After having eliminated the "non-innovators" group (Group 0), the Spearman correlation analysis was applied to the sample. However, no correlation has been found between RII and RMI (Spearman correlation coefficient SCC=0.01; sig=0.94). Representing our sample in the RII/RMI scattered plot has shown a fairly uniform distribution, biased towards the low RII/low RMI quadrant. Therefore, there are a number of companies with both, a high relative share of turnover from innovations and a high relative share of turnover from "radical" innovation in total innovation turnover (high RII and high RMI). These companies are evidently innovation leaders in the industry (Group 2 in **Error! Reference source not found.**).

The remaining part of the sample consists of the innovation followers.

On the "low RII/low RMI" side of the matrix, there are companies (Group 1c) with poor revenues from innovations and these innovations are of minor impact (presumably of incremental type, e.g. incremental improvements to the company's existing products to follow the technology or market trends).

The third group (Group 1a) of companies (high RII and low RMI) generates a notable part of its revenues out of recently introduced products. However, these products again act as substitutes to the company's existing products with no radical improvements incorporated.

Companies from the fourth group (Group 1b) produce some market inventions, resulting in new products being introduced onto the market before competitors (low RII and high RMI). Such products

normally incorporate a much higher degree of creativity. However, these companies somehow fail to make substantial revenues out of such products.

3. RELATIONSHIP BETWEEN THE INNOVATION AND BUSINESS PERFORMANCE

In the preceding chapter the method of dividing the companies active in the field of innovation into 4 groups on the basis of RII and RMI indicators was demonstrated. Companies classified in different groups differ at least pursuant to the volume and structure of their innovation revenues, i.e. direct results of innovation recorded on the market. However, differences in the revenues from innovation do not necessarily indicate also differences in the companies' business performance. Furthermore, revenues arising from innovation do not provide any conclusions as regards the organisation of innovation systems in the companies.

Let us therefore have a look as to whether there are any differences among the groups regarding their business performance. The Mann-Whitney rank sum test is applied to compare the financial ratios for the groups 0, 1 (a, b, c) and 2. The Mann–Whitney test is one of the non-parametric significance tests for assessing whether two independent samples of observations come from two populations with the same mean value [19]. This test is used in the same situations as the independent samples Student's t-test. However, as it compares medians, which are insensitive to outliers compared to means, the Mann–Whitney test is less likely to spuriously indicate significance than the t-test because of the presence of outliers – i.e. Mann–Whitney is more robust.

A detailed testing revealed that there are not any significant differences as to demographic characteristics and business performance among the groups of followers (1a, 1b and 1c). Therefore, for the purposes of simplification all three groups of followers are regarded as a homogenous group 1. A group of innovation leaders (2) is thus compared with the group of non-innovators (0) and the group of followers as a whole (1).

Error! Reference source not found. shows the values of medians for the financial ratios and significant differences in medians between the innovation leaders (2) and the non-innovators (0) as well as between the innovation leaders (2) and the followers (1). Statistically significant differences among pairs of medians are indicated in bold in the last two columns (where the value is lower than 0.05, the medians significantly differ).

As evident in **Error! Reference source not found.**, the groups 1 and 2 significantly differ as regards the return on equity ROE (invested capital creates to the owners in the group 2 by 1.4 higher gross profit and 1.4 higher net profit). At the same time the revenues appertaining to the group 2 recorded between 2006 and 2007 increased by 1.07, while the average revenues from 2003 to 2007 increased by 1.41.

Similar relations may be observed between the groups 0 and 2; additionally, statistically significant differences in return on sales (ROS) and return on assets (ROA) may be observed. Companies appertaining to the group 2 pay out 6% higher salaries than the companies in the group 0.

On the basis of the aforementioned findings it may be concluded that the companies appertaining to the group 2, which in comparison with the groups 0 and 1 innovate more successfully (achieve higher values of RII and/or RMI), record also better performance assessed with the financial ratios. Company's performance in terms of ROE proves to be 40 % higher in the group of innovation leaders that among followers and non-innovators.

4. INNOVATION INVESTMENTS STRUCTURE AND ITS EFFECT TO INNOVATION PERFORMANCE

In the following section, we analyse the innovation expenditure structure as per groups (here, group 0 was not considered due to its negligible innovation expenditures). As shown in **Error! Reference source not found.**, the leaders (Group 2) invest 3.3 % of their total turnover into innovations, which is 1.4-2 times more than each of the followers groups (Group 1, subdivided in 1a, 1b and 1c). However, as shown in **Error! Reference source not found.**, these expenditures pay; the leaders' relative share of total innovation costs in the innovation revenues is substantially lower (by almost 2 times).

What is more important from the "open innovation" viewpoint is the detailed innovation expenditure structure. As shown in **Error! Reference source not found.**, the proportion of intramural R&D expenditures (i.e. expenditures in R&D performed within the company walls) is similar in both the leaders and followers groups. But the leaders' proportion of extramural R&D expenditures is approx. twice as high as in the followers group. The leaders more intensively integrate the external organisations/experts into their R&D processes, which is obviously a way towards the open innovation paradigm. The other element of open innovation is related to the variable Expenditure in acquisition of other external knowledge which is as much as 11 times higher in the leaders group.

Also the training seems to be of high importance for the leaders. The proportion of expenditures in training counts 4-6 times more in the leaders group. An important element of a holistic innovation process is not only a creation of knowledge/R&D and potential inventions, but also their transfer into innovations. Here, the marketing phase is essential. The share of expenditures aimed into market introduction of innovations is crucial. The value of this variable is much higher in leaders group as it counts 4-5 times more compared to followers group.

Surprisingly, the share of expenditure in acquisition of machinery, equipment and software related to innovation is approx. twofold lower in the group of leaders compared to the other groups.

5. DISCUSSION

Some questions regarding the innovation capabilities of a company, with particular interest in open innovation, were researched in this paper. The main findings are summarized hereunder.

On the basis of revenues arising from innovation, expressed with coefficients RII and RMI, five groups of companies were formed – a group of non-innovators (0), 3 groups of innovation followers (1a, b, c) and a group of innovation leaders (2). The groups of followers were in part examined as a uniform group (1). We were interested as to whether there is a relationship between the revenues from innovation and the company's financial results. The group of innovation leaders (2) significantly differs from the group of followers (1) as to the return on equity (ROE), i.e. as regards the net income divided by the shareholder's equity. ROE indicates the amount of profit the company records as to the sources provided by its owners/shareholders or how many units of profit shareholders may expect to be generated per unit of invested capital. It proves evident that this is definitely an indicator which is fundamental from the investor's point of view (also/particularly for an investor who is making a decision as to whether it is reasonable to invest into the R&D and innovation or it proves more rational to invest into the traditional production factors which shall definitely provide physical growth of the company's operations (e.g. via mergers and acquisitions). Beside ROE, significant differences between the groups 1 and 2 may be observed regarding the growth of revenues from sales in the period in question. If the profit is an economic category on which it is possible to influence by way of accountancy, e.g. with an objective to lower taxes, then the growth of revenues from sales proves to be a more »factual« category. Growth of revenues from sales indicates entering new markets, increase in market shares on the existing markets or, last but not least, achieving higher selling prices. The company recording an increase in sales may be perceived as successful. The relationships between the groups 1 and 2 are similar to the relationships between the groups 0 and 2, revealing statistically significant differences also in the return on sales (ROS) and the return on assets (ROA).

We thus demonstrated that there is a correlation between the revenues arising from innovation and the financial results of a company. The companies appertaining to the group 2, which in comparison with the groups 0 and 1 innovate more successfully (record higher values of RII and/or RMI), achieve also better business performance, assessed with the financial ratios. Company's performance in terms of ROE is 40% higher in the group of innovation leaders than in the groups of followers and non-innovators.

As regards the innovation investments, the leaders invest 3.3 % of their total turnover into innovations, which is 1.4-2 times more than each of the followers group. However these expenditures pay; the leaders' relative share of total innovation costs in the innovation revenues is substantially lower. Each €1 an average leader had invested into innovation has been awarded by €14 of revenues from innovations (€7.5 in the case of followers).

Furthermore, a detailed innovation expenditure structure reveals that the leaders invest a considerably higher proportion of their innovation expenditures into the extramural R&D and in the acquisition of other external knowledge. Obviously, opening the company innovation processes to the external sources of ideas and knowledge is one of the grounds for making a company an innovation leader and a profitable one, respectively.

On the other side, innovation leaders invest a lower relative share of their innovation investments into the acquisition of machinery, equipment and software. It is still a standard praxis that companies rely on technology. But it seems to be limited to the act of buying in hope the technology will improve their innovation performance. The results of analysis show that other factors (expenses for extramural R&D, training, acquisition of other external knowledge and market introduction of innovations) are of higher importance. In this context technology seems to be only a less important tool towards achieving the innovation economic results.

Our research was based on secondary data obtained pursuant to the standardised methodology of Eurostat; however, the CIS research is primarily intended for the innovation policy-makers and not for the managers. It is thus possible that some questions important for the organisation of innovation (and open innovation, in particular) within companies were not examined. Our research shall in the future be supplemented with a survey questionnaire intended for companies' managers, which shall thus evaluate the contents not encompassed in the CIS research.

Another obstacle of our research, which could not be avoided, is a time delay with which the results of innovation activities reflect on the market. Indices RII and RMI, which are based on the revenues arising from innovations, were used as a measurement of company's performance on the market. Since these revenues refer to the period from 2004 to 2006, a substantial part of innovations was only just introduced onto the market in the time of our survey (spring 2007). Since such innovations are mostly still in the launching phase or the phase of growth, they have not yet reached their target market share and their revenues are consequently lower. Therefore, it proves reasonable to compare market data for the period after 2007 in the following steps of our research.

Investments into the external sources of ideas and knowledge, leading to a more "open" innovation, remain scarce. Even for the leaders, the relationship between intramural and extramural expenditures is 0.3. At this point, it is not possible to establish an "optimal" level of external sources, but in relative terms, for the leaders this level exceeds the followers by 100 %. However, establishing an "optimal" level could be one of the possible extensions to this research.

6. APPENDIX: TABLES AND FIGURES

Table 1*: The key output variables from the innovation process*

Variable	Definition	Measurement scale	Value range
RII – Revenues from innovation	$\frac{\text{Turnover from innovations introduced *}}{\text{Total turnover}} \times 100$	Metric	0, 100
RMI – Revenues from market innovation	$\frac{\text{Turnover from innovations new to the market}}{\text{Turnover from innovations introduced *}} \times 100$	Metric	0, 100

* either new to the market or new to the company only

Table 2*: Basic statistics for the indices RII and RMI as per innovation groups*

Group	N	Variable	Median	Mean
Non-innovators (0)	1790	RII	0.00	0.00
		RMI	-	-
Innovators in total (1 & 2)	713	RII	20.00	29.31
		RMI	40.00	41.89
Innovation followers (1c)	206	RII	10.00	9.39
		RMI	0.00	6.60
Innovation followers (1b)	195	RII	10.00	10.59
		RMI	100.00	79.39
Innovation followers (1a)	163	RII	48.00	52.42
		RMI	1.01	11.83
Innovation leaders (2)	149	RII	50.00	56.05
		RMI	71.43	74.48

Table 3*: Comparison of mean values of the financial ratios as per groups*

Variable Description	Median			Mann-Whitney test; Sig. (2-tailed)	
	Group 0	Group 1	Group 2	0 vs. 2	1 vs. 2
Return on sales – ROS	0.02	0.03	0.04	**0.02**	0.28
Total revenues per employee (€)	82,183	85,601	81,794	0.90	0.41
Net profit per employee (€)	1,906	2,439	3,079	0.17	0.53
Gross profit per employee (€)	2,332	2,905	3,490	0.25	0.55
Operating profit per employee (€)	2,963	3,168	3,976	0.37	0.57
Labour costs per employee (€)	17,690	18,396	18,884	**0.01**	0.20
Average salary per employee (€)	12,613	12,962	13,345	**0.02**	0.19
Return on equity – ROE	0.10	0.10	0.14	**0.01**	**0.00**
Return on assets – ROA	0.03	0.04	0.05	**0.04**	0.17
Sales-to-Assets	1.33	1.27	1.26	0.21	0.66
Return on equity before taxes – ROEBT	0.13	0.12	0.17	**0.02**	**0.00**
Growth of net revenues 07/06 (%)	3.63	3.60	3.84	0.06	**0.01**
Average growth of net revenues (%)	9.62	9.06	12.81	**0.01**	**0.00**

Figure 1*: RII/RMI matrix*

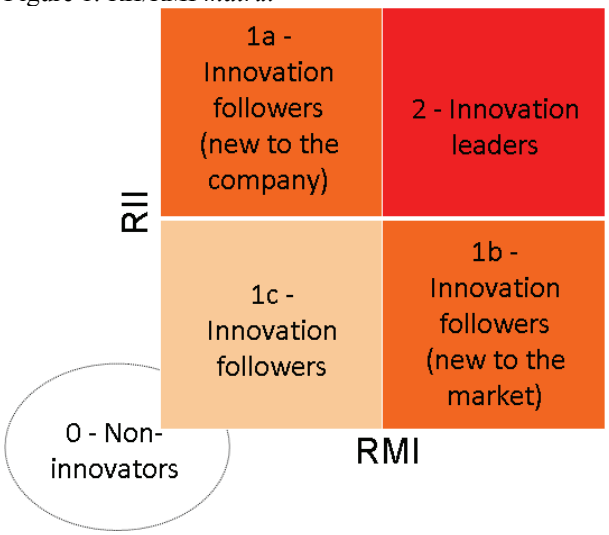


Figure 2: Total innovation expenditure as a share of total turnover

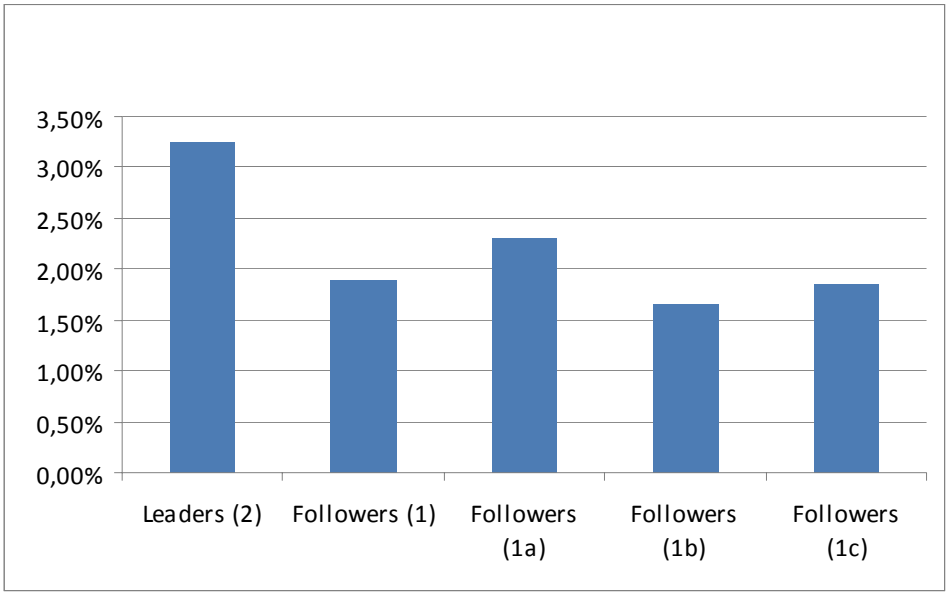


Figure 3: *Total innovation expenditure as a share of net revenues from innovations*

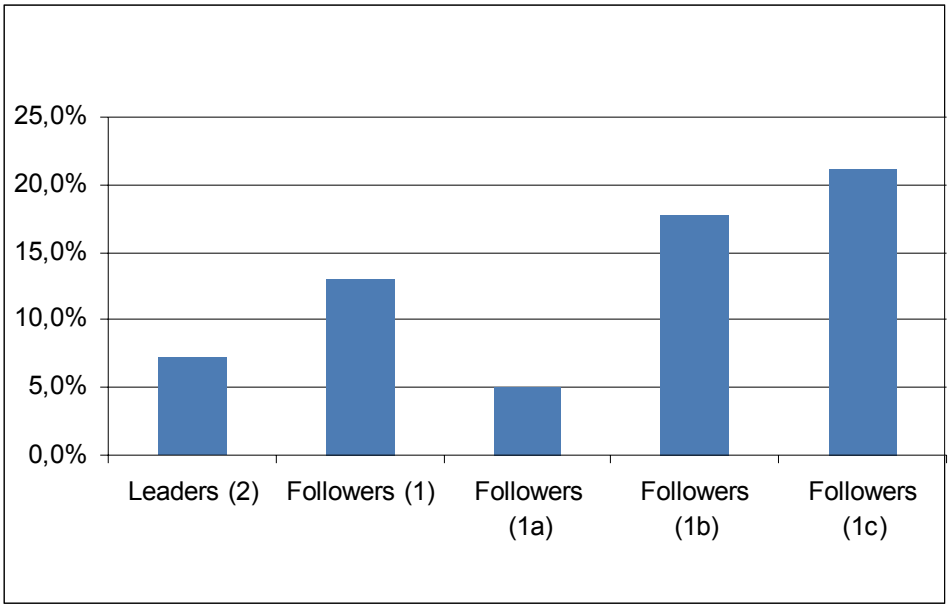
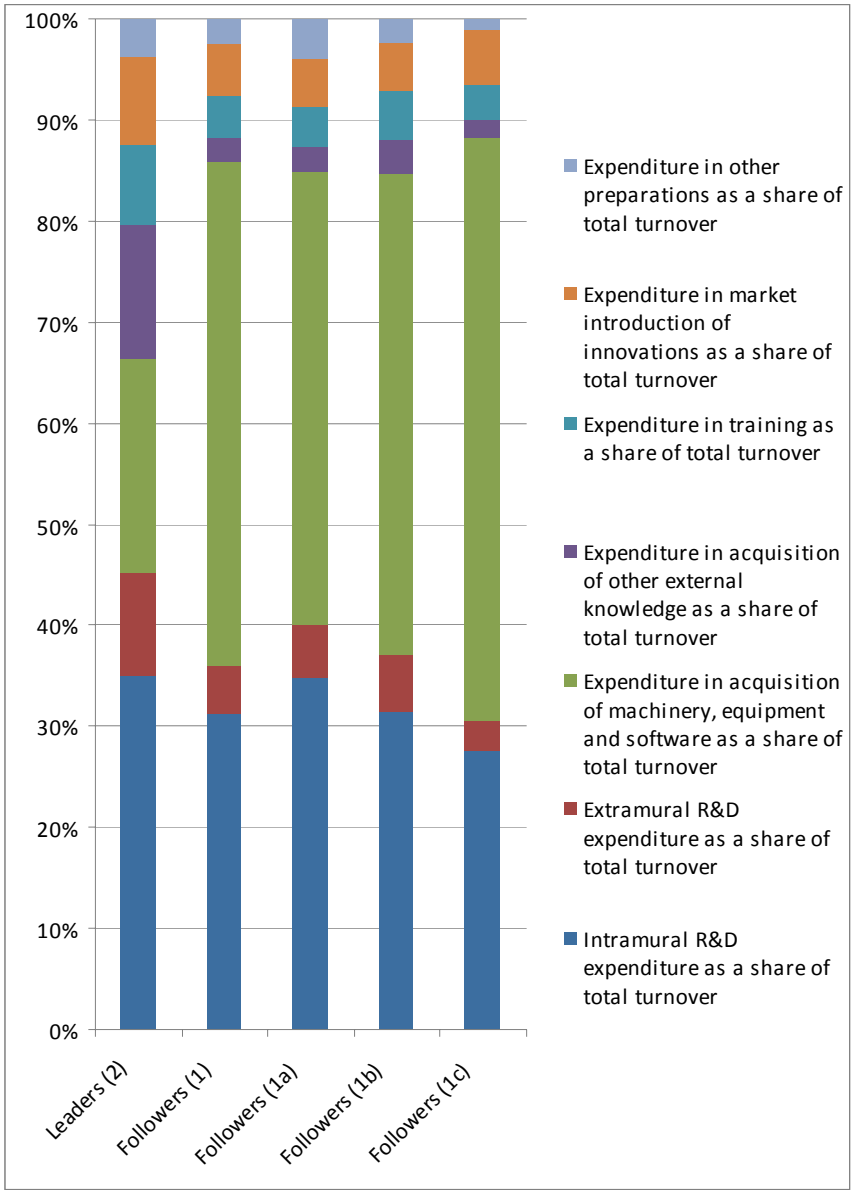


Figure 4: *Innovation expenditures structure*



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