Key Indicators - Innovation

0 Main messages

1. Innovation goes far beyond its technological dimension: **non-technological innovation** also plays an important role in the picture. Over the last decades, there has been a broadening of the very concept of innovation. Innovation is no longer to be regarded in its narrow 'technological' sense (i.e. the introduction of product or process innovations). Nowadays, it also concerns the use of new organisational models and of innovative marketing methods. These two latter dimensions are jointly described as '*non-technological innovation*'. Non-technological innovation is in most countries almost as important as, if not more important than, technological innovation. Moreover, technological and non-technological innovation show up as natural complements, as the introduction of new products and processes often involves the introduction of new business models. This calls for policies aimed at targeting *non-technological innovation* as well.

2. **The Belgian innovation landscape seems to have passed the course of the crisis**. The effects of the economic crisis were most largely felt in 2006-2008. Looking at figures for the period 2008-2010, encouraging signs of recovery appear as far as innovation is concerned.

3. **Technological innovation in the services sector** is also a very important phenomenon that should not neglected. However, service sector innovators implement strategies that are somewhat different from those put in place in the industry. Moreover, a large share of innovators in the services sector do not invest in internal R&D. More generally, innovators in the services sectors generate great on their own deal of knowledge, but their strategies mostly rely upon knowledge absorption and/or diffusion. This calls for a specific policy approach when it comes to tackling the services sector.

4. Besides there exists in general a large number of such **non-R&D technological innovators**. Technological innovation is indeed a far broader concept that entails a number of other activities, and even does not sometimes necessarily require R&D, as we have shown above. To gain the necessary knowledge to develop and implement a technological innovation, a firm can of course conduct internal R&D but it can also ask others to perform the required R&D work and buy that service (external R&D); it can purchase advanced machinery and equipment or specialized computer software; it can acquire intellectual property rights such as patents, licences, copyrights or trademarks; it can provide its personnel with the necessary training for the development or introduction of innovations, etc. These non-R&D technological innovators are mostly small and medium enterprises, and are mostly located in the services sector.

5. Going a little further in that line of analysis, it is found that **the innovation system in Belgium relies both on knowledge creation and on knowledge diffusion and absorption**. Both dimensions are important, and show up as highly complementary. All in all, this calls for wider public support to structures that enable not only the creation but also the diffusion of knowledge.

6. Our figures also shed light on the importance of two recent phenomena, namely **open innovation and internationalisation**. Open innovation refers to the fact that firms

increasingly tend to both use external knowledge for their innovation activities, and allow the outside world to access their internal knowledge. Internationalisation, on the other hand, refers to the fact that companies – and in particular multinationals – increasingly internationalize their R&D activities and, more broadly, they knowledge sourcing. For a small open economy like Belgium, it is very important to be able to assess to what extent we are linked to the rest of the world for our R&D and other innovation activities. We find significant evidence of the quantitative importance both phenomena, but as far as internationalization is concerned, no real trends emerge across periods of observation.

6. Regarding the **obstacles to innovation**, the factors that hamper firms in their willingness to innovate, it is found that it is mostly the tension between on the one hand the high costs and risks associated to innovation and on the other hand the existence of resource constraints (especially as it comes to financial resources) that is in the centre of the picture.

7. Finally, a last but fundamental question is: **why do firms innovate?** There, our results bring out the existence of demand-side considerations. Quality improvement is a very important factor, alongside with the need to satisfy customer's needs with an enlarged product range, the replacement of out dated products, or simply by reacting more quickly to their demands. Cost reduction or safety considerations do not appear to be crucial concerns as far as innovation is concerned.

1 Detailed analysis of the main indicators

A. The innovation rate - Technological and non-technological innovations

The *innovation rate* measures the proportion of firms that have introduced an innovation over a given period of time. It is often used as a metrics for the "innovativeness" of a country. This indicator can be split along the various types of innovation. We focus here on the two main broad types: technological product or process innovation on the one hand and non-technological (marketing or organisational) innovation on the other hand. To go one step further, we can even discriminate between firms that have introduced only technological innovations, only non-technological innovations, and both forms of innovation.

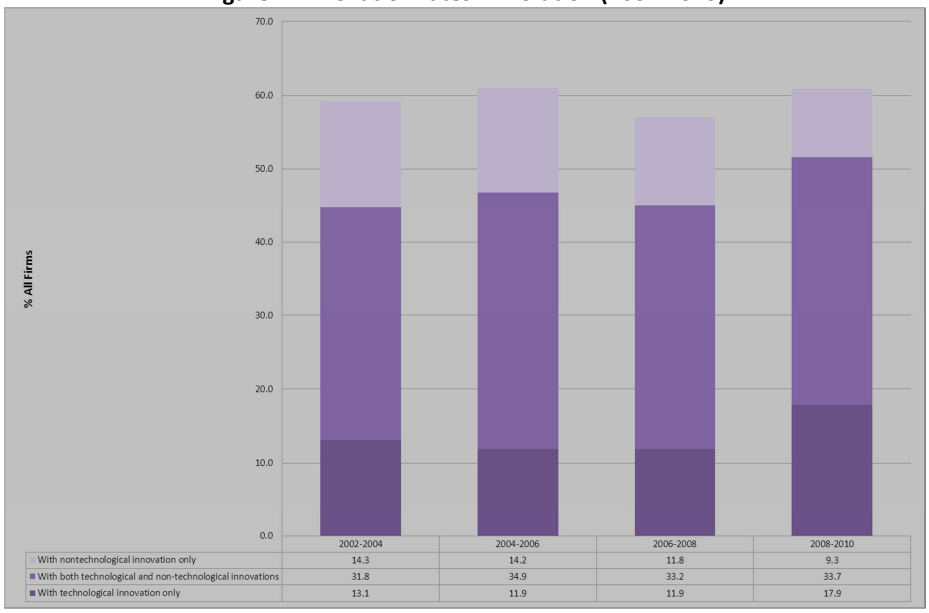
[Figure 1] shows the evolution of the various innovation rates. It conveys several messages. First, regarding the effect of the crisis, after a slight drop during the period 2006-2008, the global innovation rate is again on the rise in 2008-2010. This is due to an increase in the technological innovation rate. Second, whatever the period under scrutiny, a majority of enterprises are innovative, i.e. have introduced at least one form of innovation. Third, technological and non-technological innovations are complementary : about one-third of all the firms have introduced both forms of innovations in 2008-2010. In other words, one-half of all innovating enterprises have introduced both forms of innovations.

[Figure 2] provides a comparison with Belgium's with a set of countries based on 2 criteria: either its most important trade partners [FR, DE, NL, UK]; or (i) above the EU-average (like Belgium); and (ii) comparable to Belgium in terms of the number of inhabitants [AT, DK, IE, FI, SE]. First, it can be seen that non-technological innovation is on average a little more frequent that technological innovation but these proportions have basically the same order of magnitude. Second, Belgium does not come out so bad from this comparison, being more innovative than the average EU-27 in both dimensions. The highest innovation rates are clearly to be found in Germany. Third, Belgium scores especially

good as regards technological innovation (it scores second in the sample). But it comes to non-technological innovation, the country still scores above EU average but scores below the sample average.

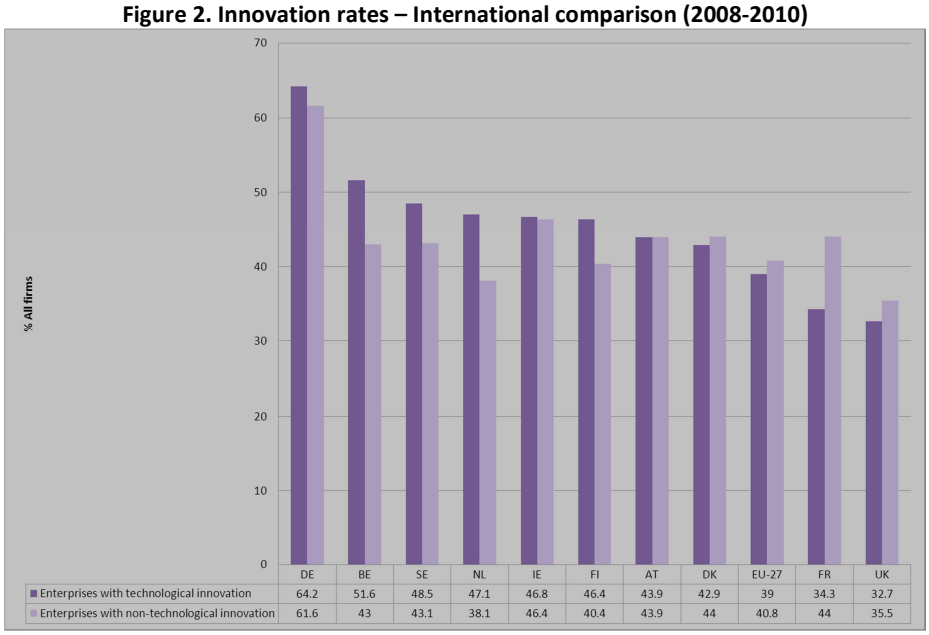
Turning to the innovation rates by branch of activity, **[Figure 3]** allows a series of interesting observations. First, the sectors with the highest technological innovation rates are '*Professional, scientific and technical activities*' and '*Information and communication*', which belong to the services part of the economy. One might at first glance have thought that service firms would be more involved in non-technological innovation while industrial enterprises would rather develop technological innovations. However, the high degree of complementarity between these two forms of innovations has already been underlined. Second, in the same vein, there is a positive correlation across sectors between technological and non-technological innovation rates (the correlation coefficient is 0.92 in our sample): the more frequent technological innovations, the more frequent non-technological innovations as well.

Figure 1. Innovation rates – Evolution (2002-2010)



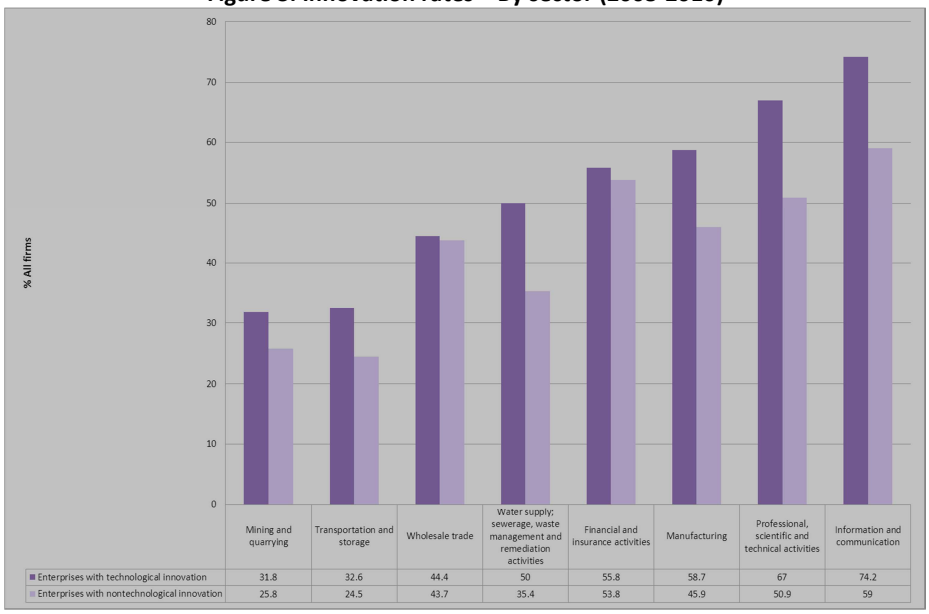
	2002-2004	2004-2006	2006-2008	2008-2010
With nontechnological innovation only	14.3	14.2	11.8	9.3
With both technological and non-technological innovations	31.8	34.9	33.2	33.7
With technological innovation only	13.1	11.9	11.9	17.9

Figure 2. Innovation rates – International comparison (2008-2010)



	DE	BE	SE	NL	IE	FI	AT	DK	EU-27	FR	UK
Enterprises with technological innovation	64.2	51.6	48.5	47.1	46.8	46.4	43.9	42.9	39	34.3	32.7
Enterprises with non-technological innovation	61.6	43	43.1	38.1	46.4	40.4	43.9	44	40.8	44	35.5

Figure 3. Innovation rates – By sector (2008-2010)



	Mining and quarrying	Transportation and storage	Wholesale trade	Water supply; sewerage, waste management and remediation activities	Financial and insurance activities	Manufacturing	Professional, scientific and technical activities	Information and communication
Enterprises with technological innovation	31.8	32.6	44.4	50	55.8	58.7	67	74.2
Enterprises with nontechnological innovation	25.8	24.5	43.7	35.4	53.8	45.9	50.9	59

B. Turnover from innovation – reaping the returns from innovation

The indicator under analysis in this section is ratio of turnover from product innovations to total turnover. It is used to measure the importance of innovation to the economy. If is also possible to refine this indicator according to the degree of novelty of innovations. A new product starts being defined as an "innovation" as soon as it is new to the firm. Therefore, we can discriminate between innovations that are only new to the firm, and more 'radical' innovations that are also new to the market.

[Figure 4] shows the evolution of this indicator. Clearly, the economic crisis seems to have had a large impact, as the indicator dropped in 2008 to less than 10%, while it used to be on average above 12%. However, it went back to its normal level in 2010, which can be interpreted as an encouraging sign of recovery.

[Figure 5] provides an international comparison for 2010, using the same comparison sample as above. Belgium does at total a little less good than the EU27 average and than its two largest neighbours, France and Germany, but somewhat better than The Netherlands. However, this result is only due to the share of turnover due to new-to-firm only innovations. Besides, one can spot some variation in the split between "new-to-firm only" and "new-to-market" shares of turnover. Belgium has a somewhat balanced position, whereas in Germany, in France and in the UK, most of the innovative turnover comes from new-to-firm only products. On the contrary, in Finland, the major share of innovative turnover comes from new-to-market products.

Figure 4. Turnover from product innovations – Evolution 2004-2010

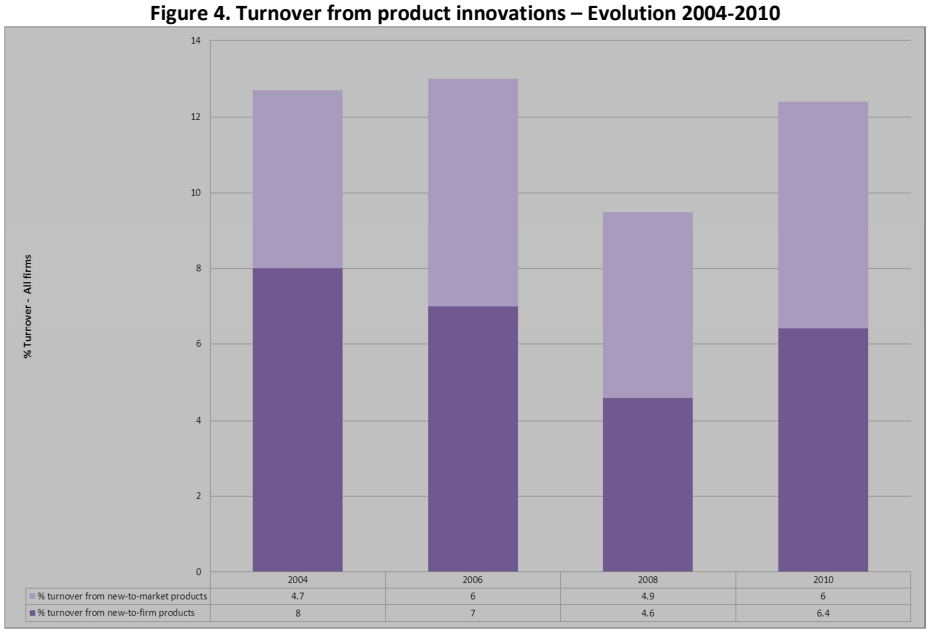
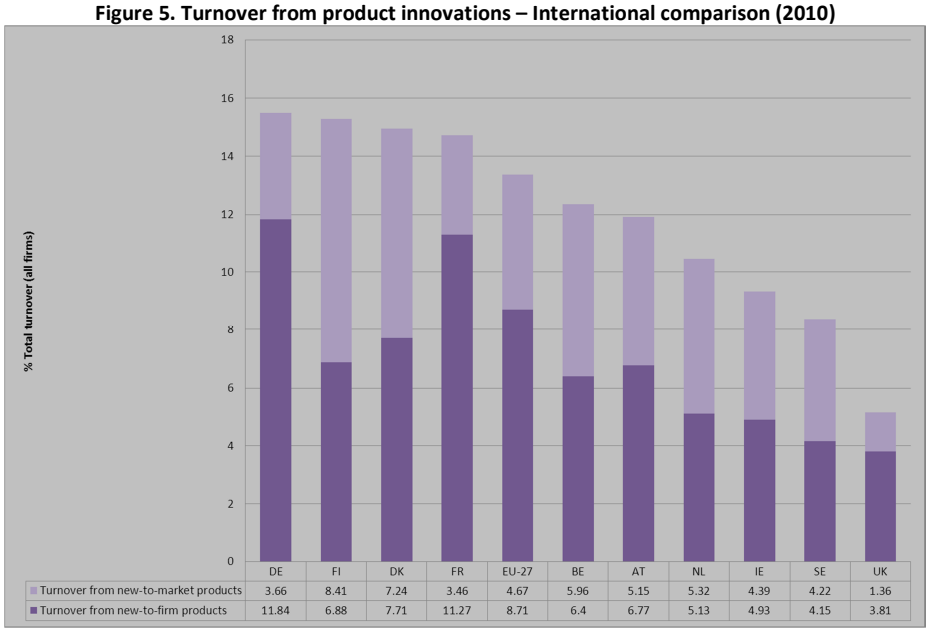


Figure 5. Turnover from product innovations – International comparison (2010)



C. The degree of novelty of technological innovations and their economic significance

As we have mentioned above, the "entry point" for an innovation is that it must be new to the firm that introduced it. We can also identify firms that introduced innovations new for their market and the associated share of turnover. The indicator presented in this Section is a composite indicator that goes step further and classifies firms according to the degree of novelty of their technological innovations and assesses the weight of these various types of innovators in the global economy. Specifically, using indicators developed by the OECD (2009)[1], we identify 5 types of technological innovators:

- *New-to-market international innovators*: these firms have introduced product innovations new to their markets, which they developed internally or in active cooperation with others, and are active international markets
- *New-to-market domestic innovators*: these firms have introduced product innovations new to their markets, which they developed internally or in active cooperation with others, but are only active on the Belgian market
- *International modifiers*: these firms have introduced either product innovations that are only new to themselves, or process innovations. But they developed these innovations internally or in active cooperation with others, and are active international markets.
- *Domestic modifiers*: these firms have introduced either product innovations that are only new to themselves, or process innovations. But they developed these innovations internally or in active cooperation with others. They are only active on the Belgian market.
- *Adopters*: these firms had their product or process innovations mostly be developed by others.

[Figure 6] shows how important each of these types of innovators is to the economy, both as a share of the total number of firms and as a share of total employment. The international dimension of innovators dominates the landscape. Also, the distribution is severely biased towards the three most "radical" types of innovators, especially in terms of employment. **[Table 1]** provides the figures that go along [Figure 6]. The third column indicated, for each category of innovators, the share of turnover that is due to innovative product. Accordingly, the more firms are "radically" innovative, the higher the turnover share from innovation. Returns from innovation seem to stem more from "real' novelties than from local adaptations or modifications.

[1] **OECD(2009)**, "*Innovation in Firms: a Microeconomic Perspective*", OECD Publishing, Paris, 2009

Figure 6. Composite indicator on the degree of novelty of innovations (2010)

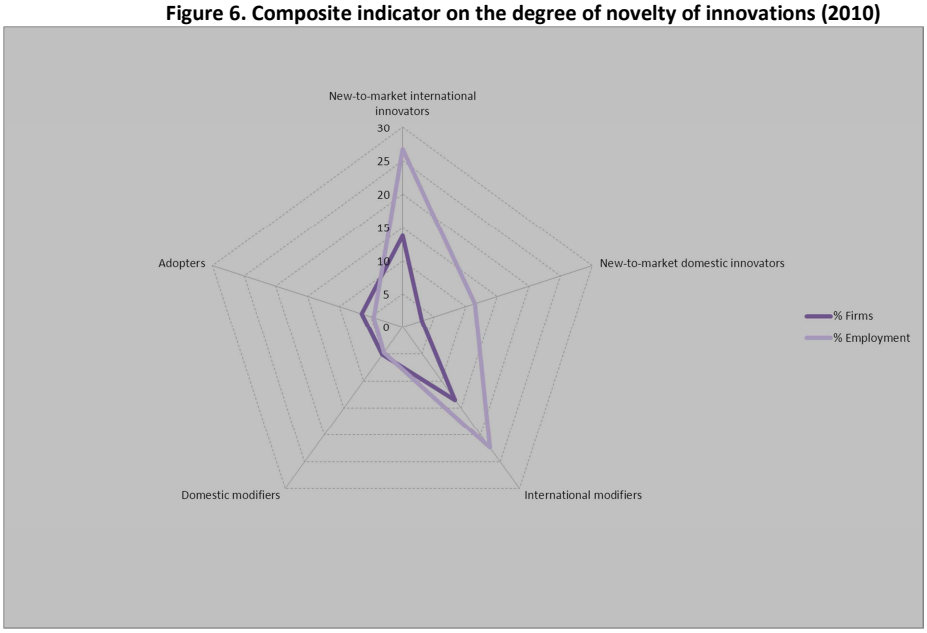


Table 1. Composite indicator on the degree of novelty of innovations (2010)

	% Firms	% Employment	Turnover from innovation*
New-to-market international innovators	13.78	26.77	26.6
New-to-market domestic innovators	3.12	11.44	24.8
International modifiers	13.45	22.39	17.9
Domestic modifiers	5.16	4.75	14.5
Adopters	6.45	4.55	15.9

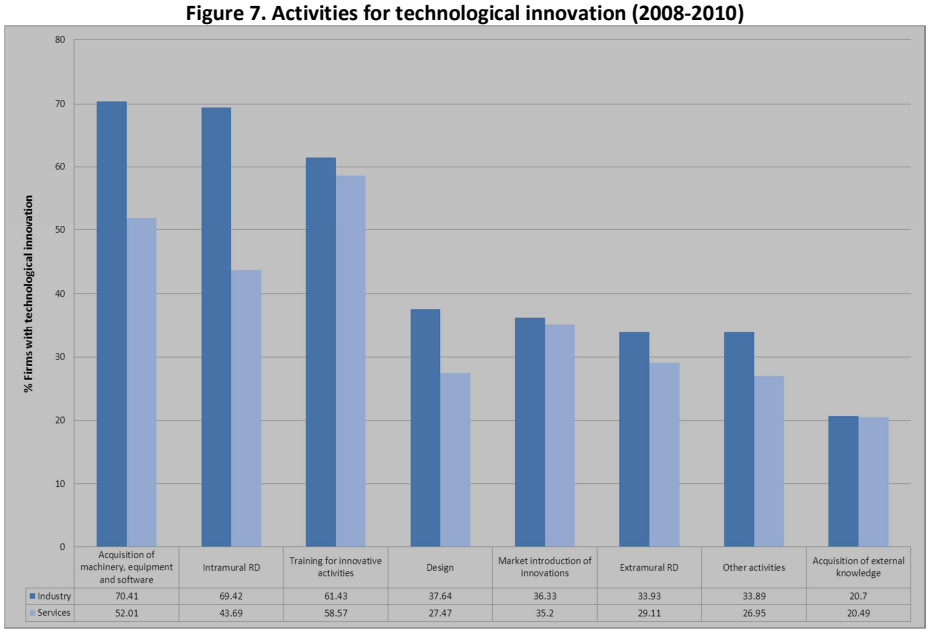
*Turnover from new-to-market and new-to-firm innovation, as a % of total turnover in the category.

D. Innovation activities– what do innovators actually do?

What kind of activities must be conducted to reach to the implementation of a workable innovation, and to what extent? The indicator under analysis here measures the proportion of technological innovators that have engaged in some particular of activities. It distinguishes services firms form industrial ones, because there is a presumption that these two kinds of firms innovate somewhat differently.

As **[Figure 7]** illustrates, the three most common activities are the acquisition of (advanced) machinery, equipment or software for innovation, training for innovative activities and intramural R&D. However some noteworthy differences and similarities between the industry and the services sector appear in broad daylight. First, while intramural R&D appears to be a very important activity in the industry sector, it is less often the case in the services sectors, though a non-negligible proportion of services innovators carry out internal R&D. Next, in the services sector, the most widely carried out innovation activity is training. It is almost as often invested in as in the industry sector. Third, the acquisition of advanced machinery or software appears to be a very popular strategy in both sectors. Finally, all other activities (design, extramural R&D, purchase of patents, etc.) seem to be only of second-order magnitude, though they are each pursued by approximately 30% of the firms, which should not be neglected.

Figure 7. Activities for technological innovation (2008-2010)



	Acquisition of machinery, equipment and software	Intramural RD	Training for innovative activities	Design	Market introduction of innovations	Extramural RD	Other activities	Acquisition of external knowledge
Industry	70.41	69.42	61.43	37.64	36.33	33.93	33.89	20.7
Services	52.01	43.69	58.57	27.47	35.2	29.11	26.95	20.49

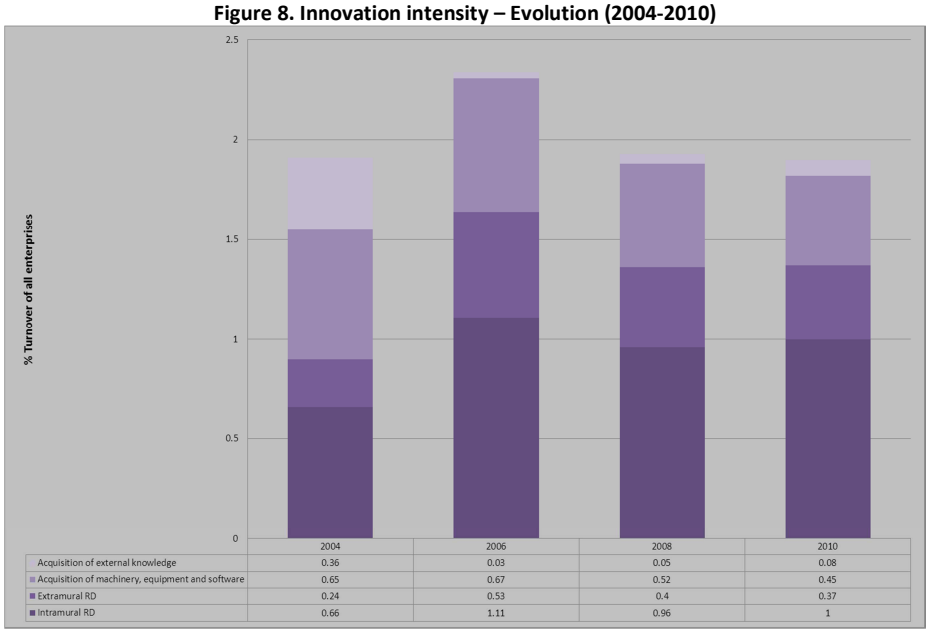
E. The innovation intensity – how much do firm spend in innovation?

On the expenditures side, we focus on only four types of them: intramural R&D; extramural R&D; acquisition of machinery, software and equipment for innovation; and acquisition of other external knowledge (patents, licences, etc..). The ratio of innovation expenditures to total turnover is called the *innovation intensity* and is a widely used indicator to measure to what extent resources are devoted to innovation.

Looking at the evolution over time, **[Figure 8]** shows that there's been a peak in 2006 – which was a booming year for the Belgian economy at large –and then the indicator returned to its 2004 level, i.e. about 1.9%. In 2010, the indicator stabilized at that level.

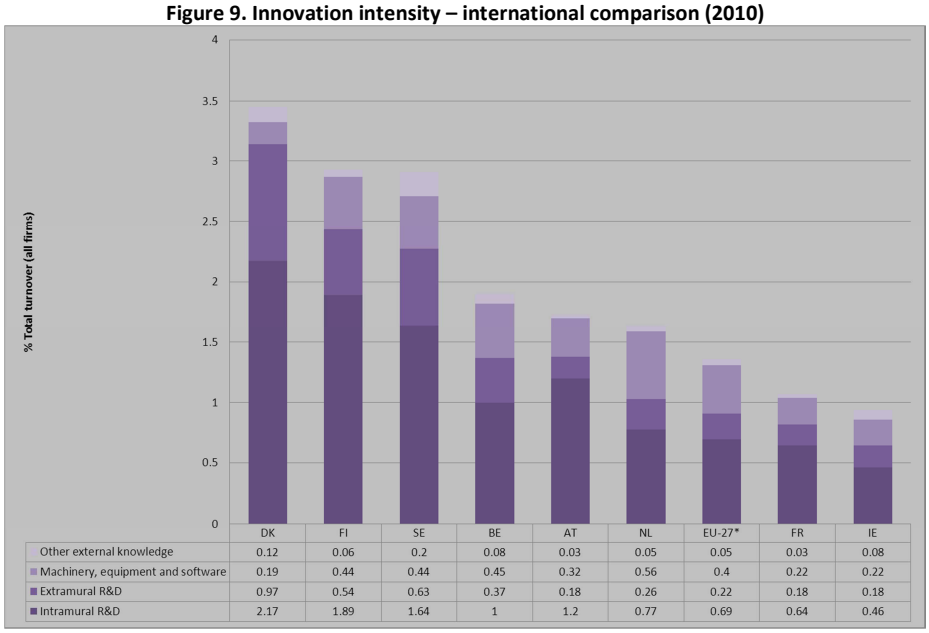
From an international point of view, **[Figure 9]** compares Belgium to the same set of countries as above (except DE and the UK, for which no data were available). It allows a distinction between several groups of countries. First, the Nordic countries (DK, FI, SE), that invest way above average in innovation. Then a group of countries that do above average (i.e. intensity between 1.5% and 2%). Belgium makes part of this group, along with comparable countries such as Austria and The Netherlands. Then finally, another group of countries that invests less than average (i.e. intensity between 1% and 1.5%). France and Ireland are part of this latter group. So, all in all, Belgian firms invest a little more than average of their turnover in innovation, but is still far from the level reached by the Nordic countries.

Figure 8. Innovation intensity – Evolution (2004-2010)



	2004	2006	2008	2010
Acquisition of external knowledge	0.36	0.03	0.05	0.08
Acquisition of machinery, equipment and software	0.65	0.67	0.52	0.45
Extramural RD	0.24	0.53	0.4	0.37
Intramural RD	0.66	1.11	0.96	1

Figure 9. Innovation intensity – international comparison (2010)



	DK	FI	SE	BE	AT	NL	EU-27*	FR	IE
Other external knowledge	0.12	0.06	0.2	0.08	0.03	0.05	0.05	0.03	0.08
Machinery, equipment and software	0.19	0.44	0.44	0.45	0.32	0.56	0.4	0.22	0.22
Extramural R&D	0.97	0.54	0.63	0.37	0.18	0.26	0.22	0.18	0.18
Intramural R&D	2.17	1.89	1.64	1	1.2	0.77	0.69	0.64	0.46

* EU-27, except Germany, Greece and the UK.

F. Non-R&D technological innovators

As illustrated above, technological innovation is not just about R&D. Innovation is a far broader concept that entails a number of other activities, and even does not sometimes require R&D. Therefore, we now focus on an indicator that measures the proportion of such non-R&D innovators i.e. the firms that have not led any internal R&D activities on their own, but may have bought external R&D services.

[Figure 10] focuses on the evolution of the indicator. Accordingly, a little more than 40% of technological innovators have not performed any internal R&D in the period 2008-2010. This proportion has continuously been rising since 2004-2006, which was a through period. The highest proportion of non-R&D innovators was however reached in 2002-2004. All in all, one can say that the proportion has been approximately stable, at a level of about 40% over the period 2002-2010.

[Figure 11] looks at the share of non-R&D technological innovators, by sector and by firm's size. Clearly, the proportion of non-R&D innovators decreases with firm size and is higher in the services sector, which conforms to basic intuition.

Figure 10. Non-R&D technological innovators – Evolution (2004-2010)

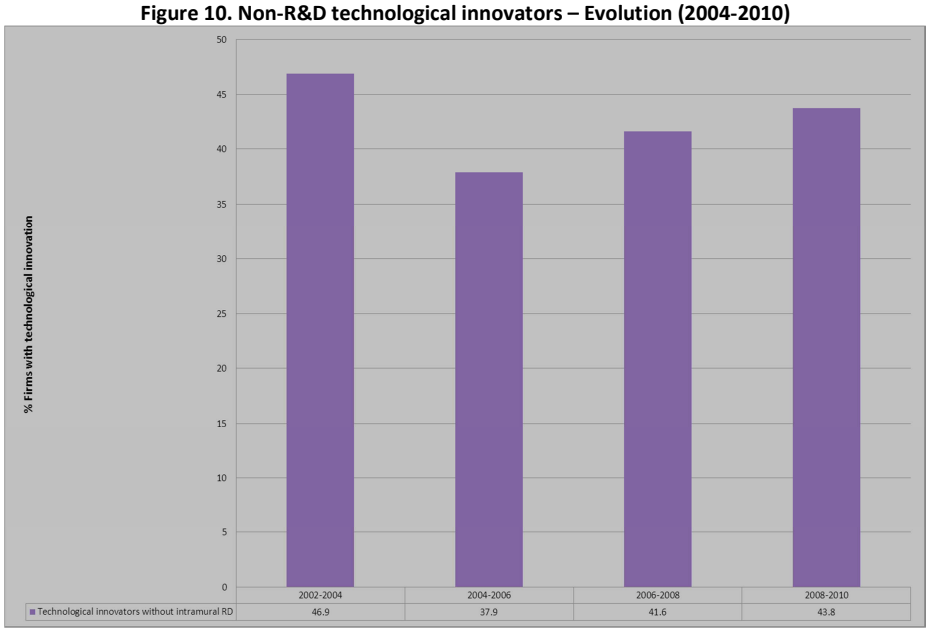
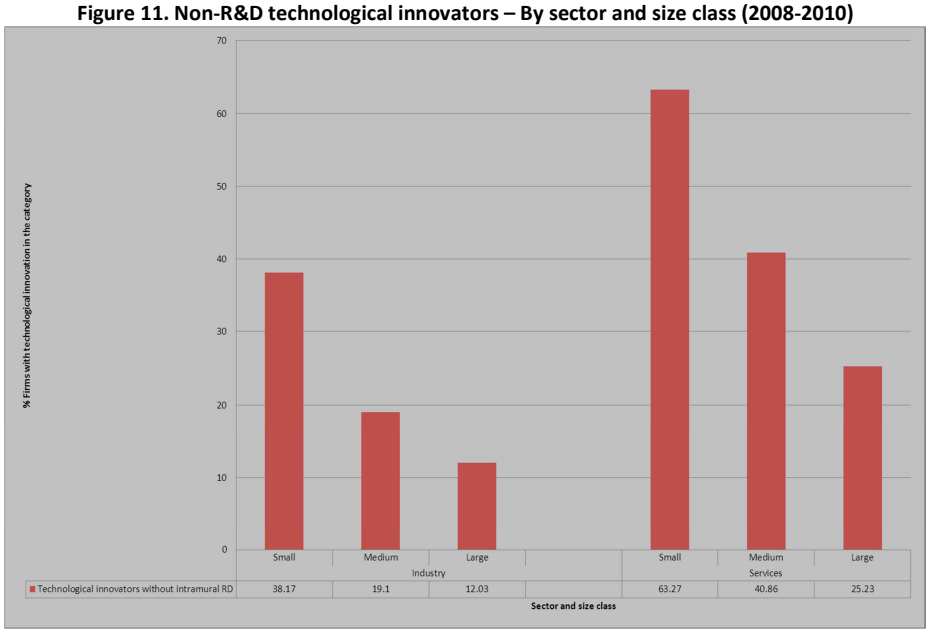


Figure 11. Non-R&D technological innovators – By sector and size class (2008-2010)



G. Creativity and diffusion

The analysis of how firms innovate can be further deepened. As already mentioned, they can indeed either generate their own knowledge, be inventive and creative. But they can also be collaborative and exchange knowledge - regardless of whether the flow is incoming or outgoing - with other institutions, through collaborations, for instance.. Innovation policy is concerned with these two dimensions: knowledge generation, on the one hand; and knowledge transmission or absorption on the other. To tackle such issues, we present a 'composite' indicator, that measures to what extent technological innovators have pursued such strategies. Accordingly, there are two main dimensions:

- Creative innovators: these firms generate their knowledge internally; they have carried out intramural R&D activities;
- Collaborative innovators: these firms source their knowledge from outside or diffuse their knowledge outside, they either engage in active cooperation or have their innovations primarily developed by others.

The indicator presents the proportion of each type of innovator, as a percentage of the total number of firms. It is illustrated in **[Figure 12]** and the corresponding numerical values can be found in **[Table 2]**. The following observations can be made about Belgium. First, a clear majority of Belgian innovators actually combine these two strategies: knowledge creation and knowledge transmission. This is especially true in the industry sector. Second, in the services sector, innovators are a little bit more prone to be collaborative and not creative. This is of course linked with the fact that non-R&D innovators are more frequent in the services sector, as documented above. However, a non-negligible 12% of services sector innovators have resorted to a combination of creation and collaboration strategies. All in all, this calls for wider public support to structures that enable not only the creation but also the diffusion of knowledge.

Figure 12. Composite indicator on creativity and diffusion (2010)

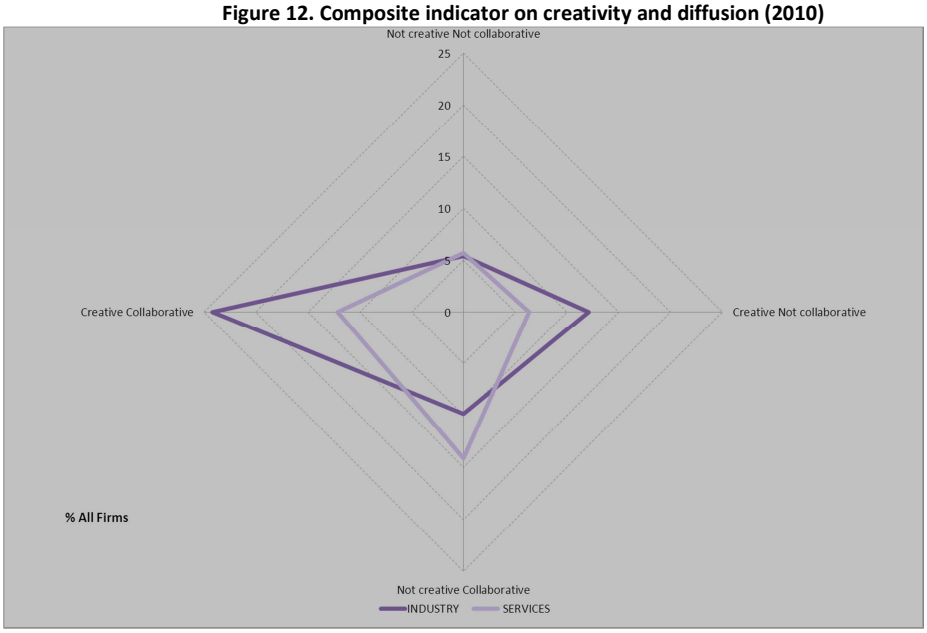


Table 2. Composite indicator on creativity and diffusion (2010)

% All firms		INDUSTRY	SERVICES
Not creative	Not collaborative	5.42	5.73
Creative	Not collaborative	12.08	6.35
Not creative	Collaborative	9.84	14.16
Creative	Collaborative	24.2	12.1

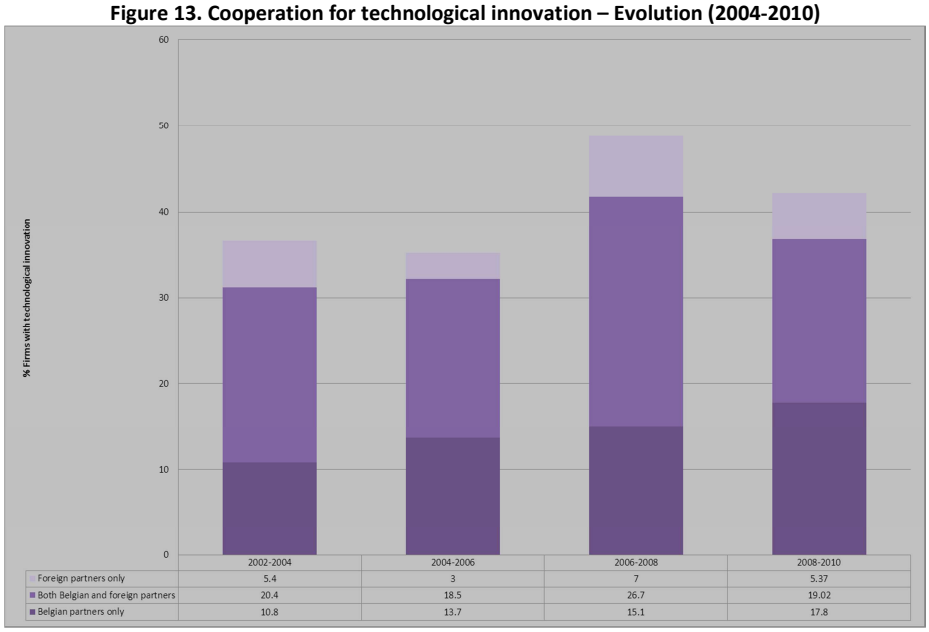
H. Collaborations – Open innovation and internationalisation

The indicator on collaboration measures the proportion of technological innovators that have developed their innovations through the implementation formal cooperation agreement with a partner (or many). This indicator is important, as it helps shedding light on the development of two recent phenomena, namely *open innovation* and *internationalisation*. Open innovation refers to the fact that firms increasingly tend to both use external knowledge for their innovation activities, and allow the outside world to access their internal knowledge. One way to access or transmit knowledge is through formal cooperation agreements. Internationalisation, on the other hand, refers to the fact that companies – and in particular multinationals – increasingly internationalize their R&D activities and, more broadly, they knowledge sourcing. Finally, this indicator also helps policy makers assessing where partnerships are the more frequent and whether or not some types of partners are underutilized.

According to **[Figure 13]**, back in 2002-2004 and 2004-2006 about one-third of technological innovators had entered cooperation agreements. That proportion jumped to over 40% in the two most recent periods of observation. This might be the effect of public policies, aimed at promoting such collaborations; but this might also turn out to be a consequence of the economic crisis that popped up from 2007 on: with resources becoming more scarce and binding financial constraints, firms are more inclined to join their forces to complete an innovation project. As far as internationalisation is concerned, we have split cooperation in three mutually exclusive schemes: with "purely domestic" partners, with "purely foreign" partners, and with both domestic and foreign partners. No striking trends seems to emerge except that, in each period, a majority of collaborative innovators enter agreements with both domestic and foreign partners.

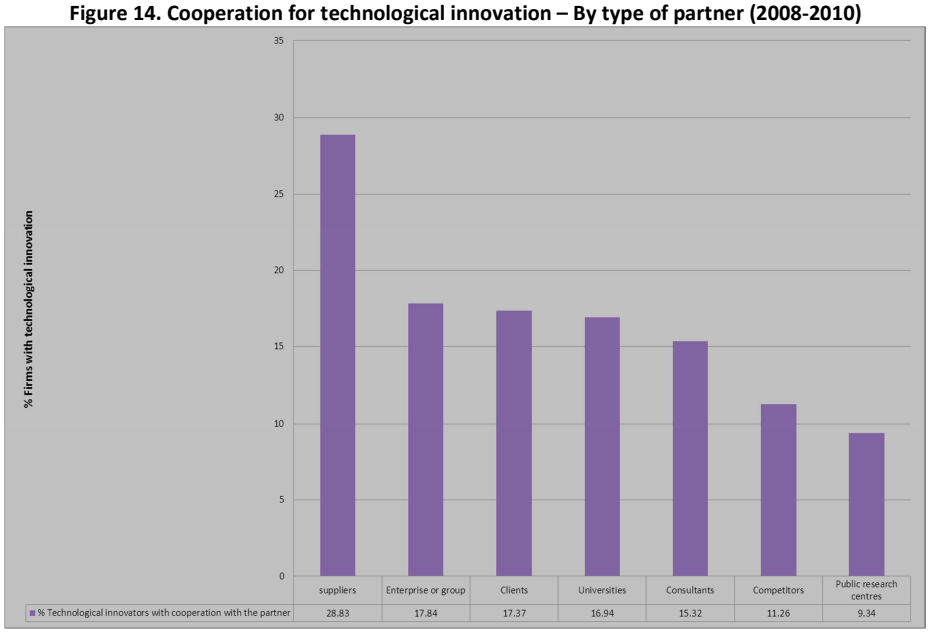
Looking at the repartition by partner type, **[Figure 14]** shows that the most commonly wooed collaboration partners are the close business relations, and especially suppliers, and the universities. Then come the consultants and private research labs. Finally, the less frequent cooperation partners are competitors and public research centres.

Figure 13. Cooperation for technological innovation – Evolution (2004-2010)



	2002-2004	2004-2006	2006-2008	2008-2010
Foreign partners only	5.4	3	7	5.37
Both Belgian and foreign partners	20.4	18.5	26.7	19.02
Belgian partners only	10.8	13.7	15.1	17.8

Figure 14. Cooperation for technological innovation – By type of partner (2008-2010)



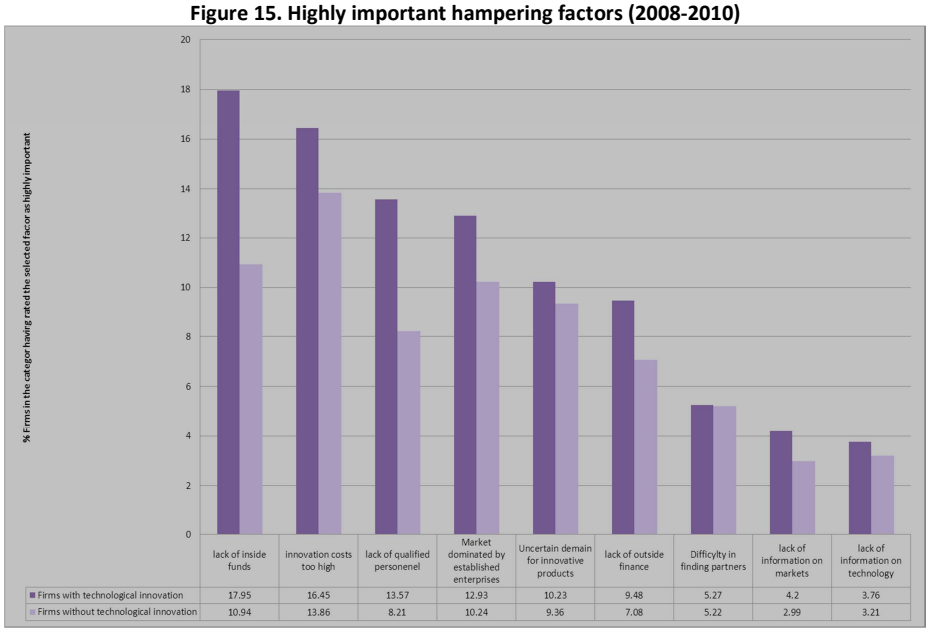
	suppliers	Enterprise or group	Clients	Universities	Consultants	Competitors	Public research centres
% Technological innovators with cooperation with the partner	28.83	17.84	17.37	16.94	15.32	11.26	9.34

I. Hampering factors – what prevents firms from being innovative?

What prevents firms from introducing technological innovations? What are the most important obstacles that technological innovators have encountered? These questions are of crucial importance to policy makers in the field. The indicator on hampering factors sheds light on these issues. For each of the hampering factors under consideration, it represents the proportion of firms in a given category (innovators/non-innovators) that have rated the factor as "highly important".

Clearly, according to **[Figure 15],** technological innovators essentially feel resource constraints (lack of inside funds, of qualified personnel, and the high costs of innovation) as major obstacles. Barriers to entry should be added to this list as well. As to why the non-innovative firms do not innovate, the picture would rather go as follows: there could too much uncertainty about the possibility of selling these innovations (market dominated by established enterprises and uncertainty about demand) with regard to development costs often considered as excessive.

Figure 15. Highly important hampering factors (2008-2010)



	lack of inside funds	innovation costs too high	lack of qualified personenel	Market dominated by established enterprises	Uncertain demain for innovative products	lack of outside finance	Difficylty in finding partners	lack of information on markets	lack of information on technology
Firms with technological innovation	17.95	16.45	13.57	12.93	10.23	9.48	5.27	4.2	3.76
Firms without technological innovation	10.94	13.86	8.21	10.24	9.36	7.08	5.22	2.99	3.21

J. Objectives of innovation – why do firms innovate?

Finally, after having analysed how they firms innovate, what they gain from innovation, and what prevents them from innovating, we now turn to a last fundamental question: why do firms innovate? The indicator distinguishes between technological innovators, marketing innovators and organisational innovators. For each type of innovators, it measures the proportion of firms that have rated the selected objective as "highly important". To save on space, we only present the results for technological and organisational innovators.

As **[Figure 16]** shows, the most common objectives of technological innovation concern the demand-side and tend to address customers' needs: increased quality and wider product diversity. Two related objectives follow: entering new markets or increasing the market share, and replacing out dated products. Supply-side objectives, such as flexibility, production capacity or cost reduction are at the bottom of the list. **[Figure 17]** also rates quality improvement as the most common objective for organisational innovation. However, the reduction of response time to customers' or suppliers' needs appears almost as important. Again, cost reduction does not seem to be a major concern to organisational innovators as well.

Figure 16. Highly important objectives of technological innovation (2008-2010)

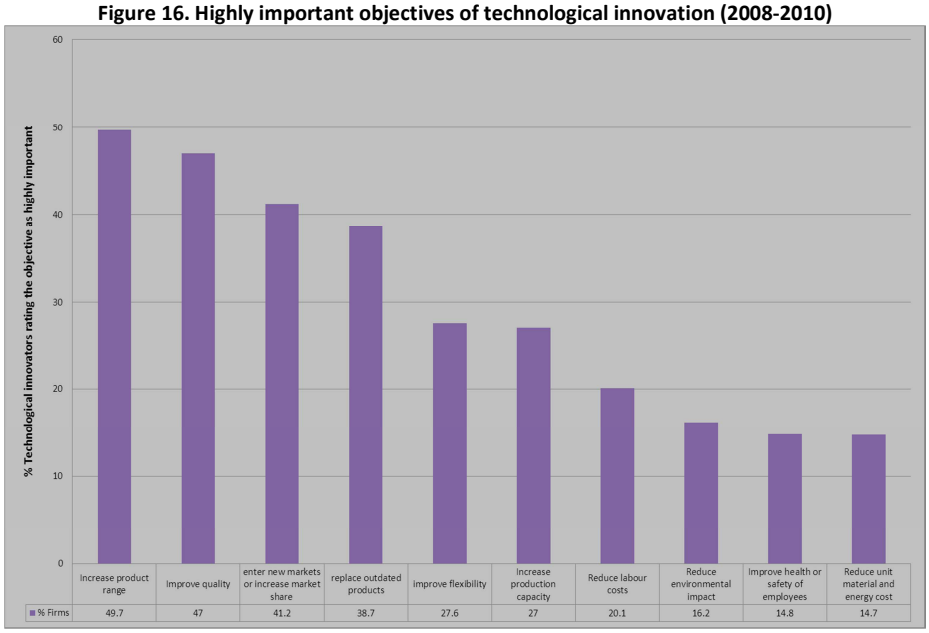


Figure 17. Highly important objectives of organisational innovation (2008-2010)