The rise of TomTom

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This paper deals with the operationalization of the balance between the concept exploration and exploitation with use of the mechanism punctuated equilibrium. The operationalization has been applied on TomTom, which had an extremely rise in sales and revenues between 2004 and 2007. In the literature it is assumed that a balance between exploration and exploitation gives a significant growth, however there is no literature about determining the balance in figures. There are two goals in this paper. Firstly, operationalizing the mechanism punctuated equilibrium and secondly to determine if the innovation strategy of TomTom contributes to the significant growth in the years 2004 till 2007, given a balance between exploration and exploitation. The innovations from TomTom during the years 2004 till 2009 and the R&D expenses from the years 2004 till 2013 have been gathered and used to analyze three variables; the length of temporal cycling, the length of an exploitation and exploration period and the timeframe for starting with development of a product till the launch of the product. The results show that no clear pattern can be found in the variables in general and the conclusion is that a balance between exploration and exploitation has not been determined in the data of TomTom.

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Exploration, exploitation, radical, incremental, innovation, punctuated equilibrium, TomTom

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1. INTRODUCTION

'The first thing to say about 2007 is that it was the most successful year in TomTom's history so far.' – Harold Goddijn, chief executive officer of TomTom

TomTom NV is a Dutch company which manufacturers automotive navigation systems and develops GPS navigation software, devices and digital maps. In the first quarter of 2004 TomTom was the first manufacturer which developed an advanced Portable Navigation Devices (PND) for a relative low price. TomTom became market leader for these PND products in Europe. The number of PND's sales had grown from the start in 2004 till 2007, with a strong growth in sales 2005 and in 2007, as shown in figure 2. In 2008 the sales decreased significantly and it never recovered like the first best years of TomTom. TomTom NV is a listed company on the AEX since 2005. In the years 2004 till 2007 there are a number of fluctuations in the revenues and profit. In table 1 the changes in revenues and sold units are shown. Figure 1 shows the trend line in the growth of sales and revenues over the years and the yearly seasonal fluctuations. The rates in table 2 show that the growth has not been linear comparing the quarters with the quarters of last year, because the revenues do not change the same percentage every year. So apart from seasonal fluctuations, the quarters have been increased significantly.

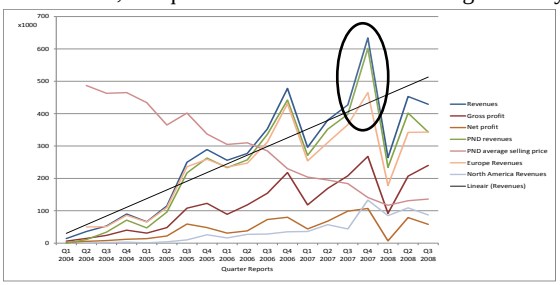

Figure 1 TomTom results '04-'08. Source: TomTom

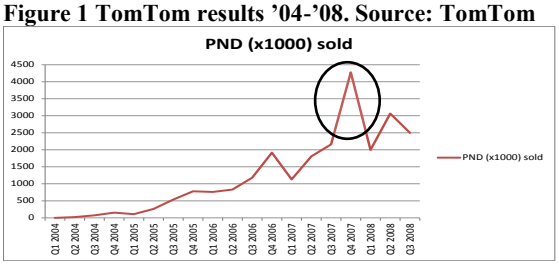

Figure 2 PND sold '04-'08. Source: TomTom

Year	Quarter	Changes in revenues	Changes in units sold
2004	Q2	155%	DNA
	Q3	47%	217%
	Q4	70%	108%
2005	Q1	-27%	-29%
	Q2	74%	144%
	Q3	117%	101%
	Q4	16%	45%
2006	Q1	-12%	-2%
	Q2	8%	9%
	Q3	27%	42%
	Q4	35%	62%
2007	Q1	-38%	-41%
	Q2	28%	60%
	Q3	12%	20%
	Q4	48%	98%
2008	Q1	-63%	-53%
	Q2	94%	54%
	Q3	-5%	-18%

Table 1 TomTom changes compared with last quarter '04-'08. Source: Financial report TomTom

% changes	2005	2006	2007	2008
q1	-	288%	16%	-11%
q2	219%	141%	67%	26%
q3	372%	41%	21%	0%
q4	221%	65%	33%	-20%

Table 2 Changes revenues compared with same quarter last year. Source: Financial report TomTom

1.1 The research problem:

There are several quarters which draw attention, looking to figures 1 and 2 and table 1. After the introduction of PND's in Q1 2004, quarter 1 of 2004, the changes in sales of the units and the revenues have been large in the quarters of 2004 and 2005. In 2006 the differences are still significant, but lower compared to previous years. In the year 2007 there is a growth in units sold, especially in Q4 2007 there has been a significant increase in the revenues and in the units sold. This quarter is also a distinctive point in figure 1, where a strong upward trend is visible in the revenues, profits and units sold compared to the increases of the last quarters. Over the years, TomTom has known seasonal fluctuations, but the increase in revenues, profit and sales in 2007 are significant higher than other fourth quarters from last years. An interesting question hereby is; what is the possible reason for this significant grow, the success, in the firm in Q4 2007? Hereby should be made clear that the other quarters after the introduction of the TomTom GO in Q1 2004 are also interesting to research more in-depth, but the focus of this research has been on Q4 2007.

In the annual report of TomTom from 2007 is stated: 'TomTom strives to lead the navigation industry in terms of innovation. We aim to take navigation to the next level by means of radical advances.' With this quote, TomTom showed their innovative image what TomTom would like to have. In 2007 there are a lot of big and smaller innovations launched on the European market, for example the TomTom ONE XL, a new design for TomTom 6, the TomTom Rider, the TomTom ONE XL-S and TomTom HD Traffic (Annual report TomTom, 2007). The numeration above shows the launch of complete new product ranges of TomTom, but also launches of products with improvements on existing products. TomTom is an organization which focuses on technological innovations. To emphasize this, a statement in the annual report of 2007 can be used 'Technological innovation is at the core of everything' (Annual report TomTom, 2007).

A striking point is the successfully launch of the HD Traffic in October and also the launch of the ONE XL-S, the first PND with HD Traffic. After the introduction the sales increased significantly (Firstpartner, 2008).

It can be concluded that TomTom focused on bigger and smaller innovations regarding the annual reports, but it is unclear if TomTom had a plain strategy for these innovations. Did TomTom made their choices for big or small innovations on a conscious mind? Did TomTom have an innovation strategy in general?

1.2 The research goal:

According March, there is need for balance between exploration and exploitation to achieve a growing performance in organizations. The growing performance in this research has

been referred in the turnover from organizations (March, 1991). If this conclusion by March is inverted, there can be stated that if an organization has a growing performance, that there is an assumed balance between exploration and exploitation. This is applicable to TomTom: the trend line in figure 1 and figure 2 show that there is a growing performance in revenues and sales in the years 2004 till 2007. For this research it is assumed, according to March, that TomTom has a balance between exploration and exploration during the years 2004 till 2007, because of the growing performance.

The balance between exploration and exploitation can be described by different mechanisms according to Gupta et al (Gupta et al, 2006): orthogonality versus continuity, duality versus specialization or ambidexterity versus punctuated equilibrium. The mechanisms are described concisely in the next sentences. Firstly, orthogonality versus continuity. Exploration and exploitation have two different and orthogonal aspects of organizational behavior with orthogonality., while exploration and exploitation has two ends of a continuum with continuity. Secondly, duality versus specialization. With duality all the organizations must strive for a balance between exploration and exploitation together, while with specialization an organization or system must focus solely on exploration or solely on exploitation. Finally, ambidexterity versus punctuated equilibrium; organization needs both exploration and exploitation to achieve persistent success. Ambidextrous organization should use both, left hand and right hand equally to be successful and punctuated equilibrium involves series of discrete periods, each focused on maximally exploiting the avaliable opportunities, rather than a more continuous evolutionary process.

It is assumed that there is a balance between exploration and exploitation within TomTom. The mechanism punctuated equilibrium describes the balance between exploration and exploitation, so it is interesting for the mechanism punctuated equilibrium that there is already a balance. In this research there will be assumed that there is a balance according to punctuated equilibrium within TomTom.

The mechanisme punctuated equilibrium has been used for this research, because TomTom is an organization which had the focus on big and small innovations: a launch of a completely new product range on the market is followed by several improvements on the product during the exploitation period. For example, when the TomTom ONE had been released, was this followed by some small improvements on the TomTom ONE during the exploitation period?

The fact that TomTom has a punctuated equilibrium is interesting for this research. This is interesting, because there already is consensus that there is need for balance between exploration and exploitation within an organization to perform well and there also is academic knowledge how to describe this balance by using mechanism punctuated equilibrium, but it is less clear how to determine punctuated equilibrium. It is less clear, because the definition of punctuated equilibrium is (too) abstract. The definition shortly: 'Punctuated equilibrium involves series of discrete periods, each focused on maximally exploiting the available opportunities, rather than a more continuous evolutionary process. The organization should have temporal cycling between short bursts of exploration and long periods of exploitation' (Benner & Tushman, 2003). The disadvantage of this definition is the qualitative way of describing punctuated equilibrium, so the quantitative part is not described: how long is the temporal cycling? What is a long period or short period? What is maximally exploitating and what are bursts of exploration? And, indirectly, it is important to know what the timeframe is for starting with development of a product till the implementation of that product. The qualitative definition of punctuated equilibrium will be the academic goal of this research; to operationalize the qualitative definition of the mechanism punctuated into quantitative within TomTom in the years 2004 to 2009.

Next to the academic interesting part, there is also a practical interesting part: there is lack in the literature about the reason for the extremely rise of TomTom in the years from the start with the first portable navigation product till the year 2007. In Q4 2007, as stated earlier, the sales and revenues have been increased significantly, but it is unclear why this happened. It is interesting to determine the reason for the extremely rise in sales in Q4 2007, the concepts exploration and exploitation and punctuated equilibrium have been used to explore the reason for this extremely rise.

1.3 Research question

'How can punctuated equilibrium be operationalized regarding TomTom, to prove the assumed balance between exploration and exploitation in the period of significant growth of sales from TomTom's products in the fourth quarter of 2007'?

2. LITERATURE REVIEW

In this part the different theories have been described and the linkage between these theories has been made. The first paragraph describes what an innovation is about. Secondly, the distinction between technological and organizational innovation have been made. The third paragraph describes the two degrees of newness regarding innovations. Fourthly, the conceptual distinction between exploration and exploitation has been made. Finally, the mechanism punctuated equilibrium has been described.

In the existing literature there are a lot of definitions where innovation is about. In this research the next definition has been used for innovations: "Innovations are concerned with the exploitation of new possibilities, through the bringing to market, or the bringing into practical use, of an idea or concept. Innovation is used to refer to a new product, process or service" (Conway & Steward, 2009).

It is important for this research to make a difference in technological innovation and organizational innovation (Poole & van de Ven, 1989). *Technological innovation* is about how firms commercialize new technological knowledge and ideas into new products or processes. *Organizational innovation* is about changes in organizational structures and administrative processes within the firm. The focus in this research will be on technological research. The primarily reason for this, is that TomTom is a technological intensive organization and, as stated in the introduction, TomTom's focus is on technological innovation.

Regarding the literature, innovations can be divided in two degrees of newness: Firstly, a radical innovation: "*Radical innovation* is a product, process, or service with either unprecedented performance features or familiar features that offer potential for significant improvements in performance and cost. Radical innovations require new skills, levels of market understanding, leaps in new processing abilities and systems throughout the organization. The newly developed product or process is so distinct from current and existing activities within the firm that the process of bringing the product to the market may not closely parallel that of any existing products within the firm" (Leifer, McDermott & O'Connor, 2000). Secondly, an *incremental innovation*: "The knowledge builds on existing knowledge, it is a major advance in the technological state-of-the-art. Incremental innovation provides for minor or major improvements in functionality and performance to an existing innovation" (Conway & Steward, 2009). He and Wong have been determined that the innovation is radical/exploration when the innovation has one of the following characteristics (He & Wong, 2004): 1. Introduce new generation of products. 2. Extend product range. 3. Open up new markets. 4. Enter new technology fields. An innovation is incremental/exploitative when the innovation has one of the following characteristics: 1. Improve existing product quality. 2. Improve production flexibility. 3. Reduce production cost. 4. Improve yield or reduce material consumption (He & Wong, 2004).

The researchers Levinthal and March determined the conceptual distinction in learning activities (Levinthal & March, 1993) within a firm, what correspondents with the characteristics of He and Wong. Firstly, the definition of exploration: "*Exploratory* innovation involves a shift to a different technological trajectory. It implies firm behaviors characterized by search, discovery, experimentation, risk taking and innovation. Exploration has been linked to radical innovations" (Burgelman, 2002) (March, 1991). Secondly, exploitation: "*Exploitative* innovations involve improvements in existing components and build on the existing technological trajectory. It implies firm behaviours characterized by refinement, implementation, efficiency, production and selection. Exploitation has been linked to incremental innovations" (Benner & Tushman, 2003) (March, 1991). This distinction is necessary for a firm, because of the scarce resources which firms have to deal with.

The reason why the pattern in this research is critical for a firm is the tension between exploration and exploitation. Hannan and Freeman established that 'adaption to existing environmental demands may foster structural inertia and reduce firms' capacity to adapt to future environmental changes and new opportunities' (Hannan & Freeman, 1984). While March established, 'experimenting with new alternatives reduces the speed at which existing competencies are improved and refined' (March, 1991). The problem with balancing exploration and exploitation is that a firm should engage in sufficient exploitation and at the same time also put sufficient effort in the exploration (Levinthal & March, 1993). By applying exploration and exploitation it is possible 'to characterize how firms strategically prioritize their investment in technological innovation with explorative versus exploitative objectives (He & Wong, 2004).

As stated above, exploration and exploitation should be balanced to realize significant performance of a firm and to survive the competitors in a market. As stated earlier, for describing this balance the mechanism punctuated equilibrium is used. *Punctuated equilibrium*: "Punctuated equilibrium involves series of discrete periods, each focused on maximally exploiting the available opportunities, rather than a more continuous evolutionary process. The organization should have temporal cycling between short bursts of exploration and long periods of exploitation" (Benner & Tushman, 2003). 'Cycling' has been defined as: 'A series of events that regularly repeated in the same order' or as 'the period of time taken to complete a cycle of events' (Oxford Dictionaries).

3. METHODOLOGY

Operationalizing the mechanism punctuated equilibrium is the first goal of this research. In this part there has been described what the steps will be to operationalize punctuated equilibrium.

As stated in the definition above, there are three variables which should be quantified within the mechanism punctuated equilibrium: 1. How long is the temporal cycling? (Which can be divided in a period to complete a cycle or series of events to complete the cycle). 2. How long is a period of maximally exploitating and how short is a 'burst' period of exploration? 3. What is the timeframe for starting with development of a product till the launch of this product?

The first variable is the length of the temporal cycling and has been determined in two ways: in the number of explorative and exploitative innovations within the temporal cycling of TomTom or the length of the period of quarters in the cyclist. As stated before, for this research the radical and incremental innovations of TomTom have been determined by the characteristics of He and Wong and March, Burgelman, Benner and Tushman. The innovations of the various products have been retrieved from TomTom, Palm info center, Pocketgpsworld, Gps, Tweakers and Navigatie help site (TomTom press releases, 2004-2009) (Palm info center news, 2004) (Pocketgpsworld, 2004) (Gps, 2004). The characteristics of incremental innovations are in the production process of the organization, so it is more difficult to determine an incremental innovation because there is less public information available about these processes. Therefore, if an innovation is not covered by one of the characteristics of an explorative/radical innovation, this innovation will be assumed to be an exploitative/incremental innovation.

The second variable is the length of a short, 'burst', period of exploration and the length of a long period of maximally exploitating. Determining this variable has been carried out by gathering the R&D expenses of TomTom from the published financial results of TomTom from the years 2004 till 2013. With this data there has been looked for a pattern in length of exploration and exploitation of TomTom. In this research, the term pattern is used to express the relation between the effort spend in exploration and the effort spend in exploitation, as have been stated in the literature by Levinthal and March; a firm should engage in sufficient exploitation and at the same

time also put sufficient effort in the exploration (Levinthal & March, 1993). When the R&D expenses are relatively high, will this be a marker for a period of exploration and when the R&D expenses are relative low or stable will this be a marker for a period of exploitation. The research of Mudambt and Swift has been used for understating these assumptions. The research of Mudambt and Swift established that R&D expenditure volatility can be an observable marker for the ability to move between periods of exploitation and exploration. 'If a firm undertakes sequential moves between exploration and exploitation, than we should observe a relatively volatile R&D expenditure profile of time' (Mudambt & Swift, 2011).

The third variable is the timeframe for starting with development of a product till the implementation of the product. This variable has been determined by listing all the radical and incremental innovations of TomTom per quarter during the years 2004 till 2009. The moment of the launch of the products has been compared with R&D expenses of TomTom in or before the same quarters. The third variable has been determined by the length of the period between the launch of a radical innovation and the relatively high R&D expenses in the preceding quarters. For the third variable, the information from variable 1 and variable 2 have been combined.

4. ANALYSIS

In this part the analysis has been elaborated. The three variables, stated earlier, have been determined and described one by one.

The first variable is the length of the temporal cycling. This variable has been determined in two ways: in the number of explorative and exploitative innovations within the temporal cycling of TomTom or the period of quarters in the cyclist. All the innovations of TomTom have been gathered and divided in explorative/radical innovation or exploitative/incremental innovation, see appendix 1. For example, the innovation TomTom GO 540 has been determined as a radical innovation, while the TomTom GO 510, 520 and 530 have been determined as an incremental innovation. The TomTom GO 540 has been the first device with HD traffic and IQ routes combined, which fulfill the checklist of He and Wong number 4; 'Enter new technology field'.

The total number of innovations from TomTom is 77 from the years 2004 till 2009. The total radical and incremental innovations are 34 and 43 respectively, see table 3.

Year	Quarter	Amount of innovations	Radical	Incremental
2004	Q1	1		1
	Q2	2	2	
	Q3	1	1	
	Q4	1		1
2005	Q1	2		2
	Q2	5	3	2
	Q3	2		2
	Q4	4	4	
2006	Q1	2	1	1
	Q2	3		3
	Q3	2		2
	Q4	1		1
2007	Q1	3	3	
	Q2	3		3
	Q3	6	2	4
	Q4	3	3	
2008	Q1	3	3	
	Q2	8	1	7
	Q3	0		
	Q4	4	4	
2009	Q1	4	1	2
	Q2	4		3
	Q3	4	3	1
	Q4	11	3	8
	Total	79	34	43

Table 3 The number of innovations, radical and incremental. Source: TomTom

The radical and incremental innovations are visualized in figure 3. The horizontal axis (x-axis) shows the time in quarters per year. The vertical axis (y-axis) shows the number of radical and the incremental innovations.

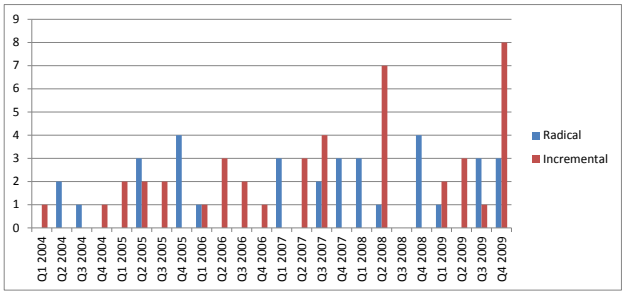

Figure 3 All innovations of TomTom 2004-2009. Source: TomTom

The innovations of TomTom have also been specified for the product ranges TomTom GO and TomTom ONE. The reason for specifying the innovations of TomTom for these specific product ranges is overlapping. It is possible that the pattern, in number of innovations, is not visible in all the innovations, however it can be visible in the specific product ranges. Appendix 2 and 3 show the innovations of TomTom GO and TomTom One. The total number of innovations of TomTom GO is 23, with 10 radical innovations and 13 incremental innovations. The total number of innovations of TomTom ONE is 13, with 2 radical innovations and 11 incremental innovations. The numbers are shown at table 3 and 4 for the product ranges TomTom GO and TomTom ONE.

Year	Quarter	Amount of innovations	Radical	Incremental
2004	Q1	DNA		
	Q2	1	1	
	Q3	0		
	Q4	0		
2005	Q1	0		
	Q2	3	3	
	Q3	0		
	Q4	0		
2006	Q1	0		
	Q2	3		3
	Q3	0		1
	Q4	0		
2007	Q1	1	1	
	Q2	0		
	Q3	3		
	Q4	0		3
2008	Q1	0		
	Q2	3		
	Q3	0		3
	Q4	3	4	
2009	Q1	0		
	Q2	0		
	Q3	1		
	Q4	5	2	3
	Total	23	11	13

Table 4 Number of innovations of TomTom GO range. Source: TomTom

Year	Quarter	Amount of innovations	Radical	Incremental
2004	Q1	DNA		
	Q2	DNA		
	Q3	DNA		
	Q4	DNA		
2005	Q1	DNA		
	Q2	DNA		
	Q3	DNA		
	Q4	1	1	
2006	Q1	0		
	Q2	0		
	Q3	1		1
	Q4	0		
2007	Q1	0		
	Q2	1		1
	Q3	1		1
	Q4	1	1	
2008	Q1	0		
	Q2	2		2
	Q3	0		
	Q4	0		
2009	Q1	0		
	Q2	3		3
	Q3	1		1
	Q4	2		2
	Total	13	2	11

Table 5 Number of innovations of TomTom ONE range. Source: TomTom

Figures 4 and 5 show the distribution of radical and incremental innovations of TomTom, classified for the specific product ranges TomTom GO and TomTom ONE. The vertical axis and the horizontal axis show the same as figure 3. The x-axis shows the time in quarters per year and the y-axis shows the number of radical/explorative innovations and incremental/exploitative innovations.

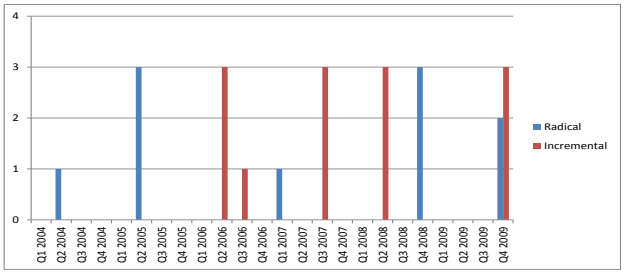

Figure 4 All innovations TomTom GO range. Source: TomTom

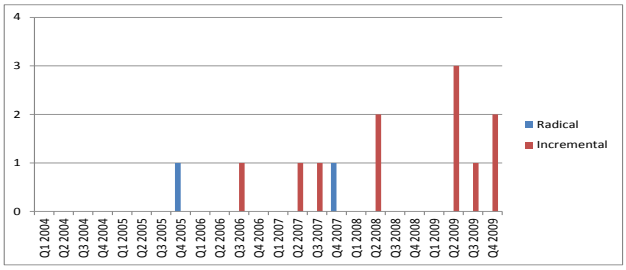

Figure 5 All innovations TomTom ONE range. Source: TomTom

The second way to determine the first variable is to look to the period of radical to radical innovations, which at least one incremental innovation in between, to determine the temporal cycling of TomTom. Tables 6, 7 and 8 show the length of a period from a radical innovation to a radical innovation. These figures support to determine the period of the cycle in quarters.

Period (radical to radical)	Length
Q2 2004 - Q2 2005	4 quarters
Q2 2005 - Q4 2005	2 quarters
Q1 2006 - Q1 2007	4 quarters
Q1 2007 - Q3 2007	2 quarters
Q4 2007 - Q4 2008	4 quarters
Q1 2009 - Q3 2009	2 quarters
Q3 2009 - Q4 2009	1 quarter

Table 6 The period from radical innovation to radical, all innovations. Source: TomTom

Period (radical to radical)	Length
Q2 2004 - Q1 2007	6 quarters
Q1 2007 - Q4 2008	7 quarters
Q4 2008 - Q4 2009	4 quarters

Table 7 The period from radical innovation to radical, TomTom GO. Source: TomTom

Period (radical to radical)	Length
Q4 2005 - Q4 2007	8 quarters
Q4 2008 - ?	>8 quarters

Table 8 The period from radical innovation to radical, TomTom ONE. Source: TomTom

The second variable is the length of a long period of maximally exploitating and the length of a short, 'burst', period of exploration. All the R&D expenses have been gathered from 2004 till 2013, see appendix 4 for all the R&D expenses. In figure 5 these R&D expenses are visualized. In this graph a growth line is visible in the R&D expenses.

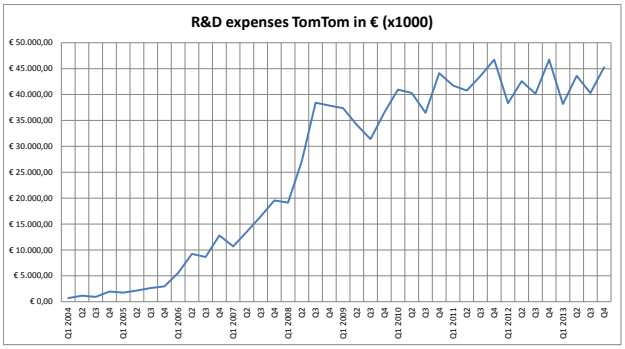

Figure 6 R&D expenses TomTom 2004 – 2013. Source: TomTom

Appendix 4 shows the changes of R&D expenses compared to the last quarter and appendix 5 shows the R&D expenses per year in a graph. The yellow markers show when the R&D expenses changed with at least 20% compared with last quarter. For this research it has been assumed that there is a significant growth in R&D expenses when the difference per quarter 20% or more. These yellow markers show the quarters when the R&D expenses are relatively volatile compared with the last quarter. The volatility of R&D shows a period of exploration, and the other (white) markers show the period of exploitation.

The third variable is the timeframe for starting with development of a product till the implementation of the product. For this variable the innovations of TomTom, appendix 1, and the R&D expenses of TomTom, appendix 2, have been compared. The third variable has been determined by the length of the period between the launch of a radical innovation and the relatively high R&D expenses in the preceding quarters Appendix 6 shows the innovations of TomTom together with the R&D expenses of TomTom. The yellow markers show, as in appendix 4, the changes of R&D above the 20% compared to last quarter. Appendix 7 shows these amounts in different graphs. The R&D changes have been shifted 1 quarter, 2 quarters, 3 quarters and 4 quarters to determine the timeframe for starting with a development of a product till the implementation of the product. This method has been used to determine a period in the amount of investment and how long it takes to launch the (radical) product on the market, which is shown in appendix 8. The bold numbers in the yellow markers show when a radical product is in line with a significant change in R&D expenses. The intention is that the radical products should be in line with the shifted yellow marked numbers. These bold numbers have been counted and the totals have been shown on the bottom of the table. The amount of bold when shifting 1 quarter is 5 times, when shifting 2 quarters the amount is 7 times, when shifting 3 quarters the amount is 5 times and when shifting 4 quarters the amount is 5 times. The same as above has been done for the specific ranges GO and ONE as well. This is shown in appendix 9 and 10. The results show that the TomTom GO the amount of bold when moving 1 quarter is 2 times, when moving 2 quarters the amount is 2 times, when moving 3 quarters the amount is 1 time and when moving 4 quarters the amount is 2 times. The results show that the TomTom GO the amount of bold when moving 1 quarter is 2 times, when moving 2 quarters the amount is 1 time, when moving 3 quarters the amount is 0 time and when moving 4 quarters the amount is 1 time.

5. CONCLUSION

In this part the results of analysis have been discussed. The variables have been discussed one by one.

The first variable is the length of the temporal cycling expressed by the number and the period of explorative and exploitative innovations. The graph in figure 3 shows a pattern in the number of explorative/radical innovations and in exploitative/incremental innovations from TomTom. The radical innovations of TomTom have been followed up by incremental innovations of TomTom. However, the number of radical and incremental innovations, as well as the period between radical innovations, is varying considerably. A fixed pattern cannot be recognized in the number of radical innovations and incremental innovations. So the temporal cycling in all the innovations of TomTom is not constant, but various. This means that it is not possible to say, for example, that 2 radical innovations will be followed up by 5 incremental innovations. It is remarkable that the number of radical innovations is relatively high compared to the number of incremental innovations. In figure 4 and 5 show for both, GO and ONE, that one of a few radical innovations are followed up by a number of incremental innovations over a longer time period.

The second way to determine variable one; the temporal cycling of TomTom by looking to the period of the innovations. Tables 6, 7 and 8 show the length of the period from a radical innovation to a radical innovation, with at least one incremental innovation in between. Looking to table 6, about all innovations, the length of 2 quarters followed by 4 quarters and then followed by 2 quarters is visible. This can mean that the temporal cycling of TomTom is 4 quarters and 2 quarters. The length of the specific ranges GO and ONE of TomTom is visible in tables 7 and 8, these tables show a various pattern as well, but relatively long compared to the periods in table 6.

The second variable is the length of a long period of maximally exploitating and the length of a short, ‘burst’, period of exploration. The results of appendix 4 show that 2 quarters of exploration, a significant rise in R&D expenses, was followed by 1 quarter of exploitation. This happens four times in the period 2004 and 2008, the period of the rise of TomTom. Between 2008 and 2013 this does not occur anymore. The number of four periods is too less compared to the total number of quarters. There can be concluded that the period of exploration is relatively long compared to the period of exploitation.

The third variable is the timeframe for starting with development of a product till the implementation of the product. The results of linking the innovations of TomTom to the R&D expenses, appendix 8, show that the timeframe of 2 quarters have matched the radical innovations to the R&D expenses the most times, but this number differs not significantly with the other periods.

6. DISCUSSION

All the three variables have been analyzed and conclusions have been made in previous parts. In this part the results will be discussed.

The research question is: 'How can punctuated equilibrium be operationalized regarding TomTom, to prove the assumed balance between exploration and exploitation in the period of significant growth of sales from TomTom's products in the fourth quarter of 2007'?

The first part of the research question is 'how can punctuated equilibrium be operationalized regarding TomTom'. The definition of punctuated equilibrium is: 'Punctuated equilibrium involves series of discrete periods, each focused on maximally exploiting the available opportunities, rather than a more continuous evolutionary process. The firm should have temporal cycling between long periods of exploitation and short bursts of exploration'.

The results show that the expected pattern of temporal cycling has not been established by the number of radical and incremental innovations of TomTom. The number of innovations as well as the periods are varying. but it can be possible to determine the temporal cycling in periods of radical and incremental innovations. The results show that the temporal cycling period of TomTom is 4 quarters of exploration, followed by 2 quarters of exploitation. As stated in the literature, the period of exploration should be relatively short compared to the period of exploitation. This research shows that, within TomTom, the assumed balance has not been determined. Given the relatively high number of radical innovations, it looks like that TomTom has too many invested on radical innovations. The growing performance of TomTom has probably been achieved by other elements.

The second variable, the length of period of exploitation and the length of the period of exploration, cannot be determined, because there is no unambiguous link visible in linking the R&D expenses of TomTom with the innovations of TomTom.

All in all, this research shows that there are number of ways to operationalize the mechanism punctuated equilibrium. The methods of variable 1, i.e. the number and periods of innovations, have made clear the discrete periods of the punctuated equilibrium. The methods of variable 2 and 3 made less clear the discrete periods of exploration and exploitation. This is mainly caused by the lack of detailed information about the distribution of R&D expenses of TomTom in radical and incremental innovations.

Answering the second part of the research question: 'to prove the assumed balance between exploration and exploitation in the period of significant growth of sales from TomTom's products in the fourth quarter of 2007'? There can be concluded that the expected pattern between exploration and exploitation has not been found in the data of TomTom in the years 2004 till 2009. So it is questionable if the reason for the growth of TomTom is assignable to a clear innovation strategy of TomTom or to something else. Questions hereby; did TomTom translate their innovation strategy to a tactical level or did TomTom have an innovation strategy in general? Did TomTom focus too much on the exploration and too less on the exploitation? In other words, did TomTom made explicit choices in effort spend in exploration and exploitation in general and thereby, as stated literature, risk the continuity of the firm on the long term? These subjects can be researched more in depth.

7. LIMITATIONS

This paper has encountered some limitations during the exercise of this research. Firstly, to allocate an innovation in radical and incremental is not 100% reliable in a few cases. For example, it is possible that an innovation is determined as a radical innovation, but should be an incremental innovation. Thereby, an incremental innovation is often done in the production process and this information is not available outside TomTom. For this reason, if an innovation is not covered by one of the characteristics of a radical innovation, it has been assumed as an incremental.

Next to this, with variable 2 and 3, it has been difficult to determine the period of exploration and exploitation, because there is no information available about the way TomTom spent their R&D expenses in radical and incremental innovations.

This research has been focused on the technological innovations and the effect of organizational innovations has not been considered.

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9. APPENDIX

Appendix 1: All innovations

Year	2004					2005												
Quarter	q1 2004	q2	q2	q3	q4	q1 2005	q1	q2	q2	q2	q2	q2	q3	q3	q4	q4	q4	q4
Date	18-03-04	1-05-04	1-05-04	1-09-15	1-12-04	1-03-05	9-03-05	10-04-05	10-04-05	10-04-05	1-05-05	1-05-05	9-08-05	22-08-05	1-11-05	22-11-05	28-11-05	12-12-05
Innovation	TomTom Navigator 3	TomTom GO Classic	TomTom Traffic Update service	TomTom Mobile	TomTom Docking Kit for GO	TomTom HP Navigation Pack	TomTom GO Traffic Receiver	TomTom GO 300	TomTom GO 500	TomTom GO 700	TomTom Navigator 5	TomTom Mobile 5	TomTom Mobile 5 Sony	TomTom Mobile 5 Nokia	TomTom ONE	TomTom Rider	TomTom PLUS	Memory card all maps
Checklist:																		
Introduce new generation of products	-	X	X	X	-	-	-	X	X	X	-	-	-	-	X	X	X	-
Extend product range	-	X	-	X	-	-	-	X	X	X	-	-	-	-	X	X	X	-
Open up new markets	-	X	-	X	-	-	-	-	-	-	-	-	-	-	X	X	X	-
Enter new technology fields	-	X	X	X	-	-	-	X	X	X	-	-	-	-	-	-	-	X
Radical innovation/exploration?		Radical	Radical	Radical				Radical	Radical	Radical					Radical	Radical	Radical	Radical
If not; Improve existing product quality	X				X	X	X	-	-	-	X	X	X	X	-	-	-	-
Improve production flexibility	X				X	X		-	-	-	-				-	-	-	-
Reduce production cost	-				-	-		-	-	-	-				-	-	-	-
Improve yield or reduce material consumption	-				-	-		-	-	-	-				-	-	-	-
Incremental innovation/exploitation?	Incremental				Incremental	Incremental	Incremental	-	-	-	Incremental	Incremental	Incremental	Incremental	-	-	-	-
Radical/Exploration = 1, Incremental/Exploitation = 2	2	1	1	1	2	2	2	1	1	1	2	2	2	2	1	1	1	1

Year	2006								2007															
Quarter	q1 2006	q1	q2	q2	q2	q3	q3	q4	q1 2007	q1	q1	q2	q2	q2	q2	q3	q3	q3	q3	q3	q3	q4	q4	q4
Date	1-03-06	1-03-06	1-04-06	1-04-06	1-04-06	1-09-06	1-09-06	28-11-06	8-01-07	15-03-07	15-03-07	17-04-07	20-05-07	20-05-07	1-06-07	1-06-07	1-06-07	5-06-07	1-05-07	30-08-07	11-09-07	12-11-07	12-11-07
Innovation	TomTom WORK	TomTom PLUS	TomTom GO 510	TomTom GO 710	TomTom GO 910	TomTom Navigator 6	TomTom ONE	New maps	FM Transmitter	TomTom GO 715	TomTom Webfleet	Maps update	TomTom RIDER	TomTom ONE XL	TomTom GO 520	TomTom GO 720	TomTom GO 920	TomTom Map Share	TomTom Academy	TomTom ONE 3rd edition	TomTom embedded PND	Travel Time Information	TomTom XL HD	
Checklist:																								
Introduce new generation of products	X	-	-	-	-	-	-	-	-	X		-	-	-	-	-	-	-	X	-	X	-	-	
Extend product range	X	-	-	-	-	-	-	-	-	X		-	-	-	-	-	-	-	X	-	X	-	-	
Open up new markets	X	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	X	-	X	-	-	
Enter new technology fields	X	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	X	X	-	X	X	X	
Radical innovation/exploration?	Radical								Radical	Radical	Radical							Radical	Radical		Radical	Radical	Radical	
If not; Improve existing product quality	-	X	X	X	X	X	X	X	-		-	X	X	X	X	X	X			X	-	-	-	
Improve production flexibility	-	-	X	X	X				-		-										-	-	-	
Reduce production cost	-	-	-	-	-				-		-										-	-	-	
Improve yield or reduce material consumption	-	-	-	-	-				-		-										-	-	-	
Incremental innovation/exploitation?	-	Incremental	Incremental	Incremental	Incremental	Incremental	Incremental	Incremental				Incremental	Incremental	Incremental	Incremental	Incremental	Incremental			Incremental				
Radical/Exploration = 1, Incremental/Exploitation = 2	1	2	2	2	2	2	2	2	1	1	1	2	2	2	2	2	2	1	1	2	1	1	1	

Year	2008															2009					
Quarter	q1 2008	q1	q1	q2	q2	q2	q2	q2	q2	q2	q2	q4	q4	q4	q4	q1 2009	q1	q1	q2	q2	q2
Date	15-01-08	12-02-08	3-03-08	20-04-08	20-04-08	20-04-08	20-04-08	20-04-08	20-04-08	1-05-08	1-05-08	29-10-08	29-10-08	29-10-08	3-12-08	7-01-09	3-03-09	3-03-09	1-04-09	1-04-09	1-06-09
Innovation	TomTom LINK 300	Content Sharing Platform	HD Traffic Receiver	IQ Routes	TomTom GO 930	TomTom GO 730	TomTom GO 530	TomTom WEBFLEET	TomTom GO Accessories	TomTom ONE	TomTom ONE XL	TomTom GO 540	TomTom GO 740	TomTom GO 940	TomTom Route Planner	TomTom semi-embedded 2nd	TomTom S-E 2nd for Toyota	TomTom S-E 2nd for Renault	TomTom ONE IQ	TomTom XL IQ	TomTom ONE LIVE
Checklist:																					
Introduce new generation of products	-	-	-	-	-	-	-	-	-	-	-				X	X	-	-			
Extend product range	-	-	-	-	-	-	-	-	-	-	-				X	X	-	-			
Open up new markets	-	-	-	-	-	-	-	-	-	-	-				-	X	-	-			
Enter new technology fields	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X	X	-	-			
Radical innovation/exploration?	Radical	Radical	Radical	Radical								Radical	Radical	Radical	Radical	Radical		??			
If not; Improve existing product quality	-	-			X	X	X	X	X	X	X						X	X	X	X	X
Improve production flexibility	-	-																			
Reduce production cost	-	-																			
Improve yield or reduce material consumption	-	-																			
Incremental innovation/exploitation?					Incremental	Incremental	Incremental	Incremental	Incremental	Incremental	Incremental						Incremental	Incremental	Incremental	Incremental	Incremental
Radical/Exploration = 1, Incremental/Exploitation = 2	1	1	1	1	2	2	2	2	2	2	2	1	1	1	1	1	2	2	2	2	2

Year															
Quarter	q3	q3	q3	q3	q4	q4	q4	q4	q4	q4	q4	q4	q4	q4	q4
Date	3-08-09	21-09-09	16-09-09	28-09-09	1-10-09	1-10-09	1-10-09	1-10-09	1-10-09	1-10-09	1-10-09	12-10-09	12-11-09	25-11-09	1-12-09
Innovation	TomTom GO 9000	TomTom OpenLR	TomTom Blue&Me	TomTom XL 340S LIVE	TomTom XXL 530s	TomTom XXL 540s	TomTom GO 550 LIVE	TomTom GO 750 LIVE	TomTom GO 950 LIVE	TomTom GO 7000 Truck	TomTom START	TomTom car kit	TomTom WORK webfleet	TomTom Carminat update	TomTom GO I-90
Checklist:															
Introduce new generation of products	X	-	X	-	-	-	-	-	-	X	X	-	-	-	X
Extend product range	X	-	X	-	-	-	-	-	-	X	X	-	-	-	X
Open up new markets	X	-	X	-	-	-	-	-	-	X	X	-	-	-	X
Enter new technology fields	X	X	X	-	-	-	-	-	-	-	-	-	-	-	X
Radical innovation/exploration?	Radical	Radical	Radical							Radical	Radical	??			Radical
If not; Improve existing product quality				X	X	X	X	X	X			X	X	X	
Improve production flexibility															
Reduce production cost															
Improve yield or reduce material consumption															
Incremental innovation/exploitation?				Incremental	Incremental	Incremental	Incremental	Incremental	Incremental			Incremental	Incremental	Incremental	
Radical/Exploration = 1, Incremental/Exploitation = 2	1	1	1	2	2	2	2	2	2	1	1	2	2	2	1

Appendix 2: All innovations from TomTom GO range

Quarter	q2 2004	q2	q2	q2	q2 2006	q2	q2	q1 2007	q3	q3	q3	q2 2008	q2	q2	q4	q4
Date	1-05-04	10-04-05	10-04-05	10-04-05	1-04-06	1-04-06	1-04-06	15-03-07	1-06-07	1-06-07	1-06-07	20-04-08	20-04-08	20-04-08	29-10-08	29-10-08
Innovation	TomTom GO Classic	TomTom GO 300	TomTom GO 500	TomTom GO 700	TomTom GO 510	TomTom GO 710	TomTom GO 910	TomTom GO 715	TomTom GO 520	TomTom GO 720	TomTom GO 920	TomTom GO 930	TomTom GO 730	TomTom GO 530	TomTom GO 540	TomTom GO 740
Checklist:																
Introduce new generation of products	X	X	X	X	-	-	-	X	-	-	-	-	-	-		
Extend product range	X	X	X	X	-	-	-	X	-	-	-	-	-	-		
Open up new markets	X	-	-	-	-	-	-	-	-	-	-	-	-	-		
Enter new technology fields	X	X	X	X	-	-	-	X	-	-	-	-	-	-	X	X
Radical innovation/exploration?	Radical	Radical	Radical	Radical				Radical							Radical	Radical
If not; Improve existing product quality		-	-	-	X	X	X		X	X	X	X	X	X		
Improve production flexibility		-	-	-	X	X	X									
Reduce production cost		-	-	-	-	-	-									
Improve yield or reduce material consumption		-	-	-	-	-	-									
Incremental innovation/exploitation?		-	-	-	Incremental	Incremental	Incremental		Incremental	Incremental	Incremental	Incremental	Incremental	Incremental		
Radical/Exploration = 1, Incremental/Exploitation = 2	1	1	1	1	2	2	2	1	2	2	2	2	2	2	1	1

Appendix 3: All innovations from TomTom ONE range

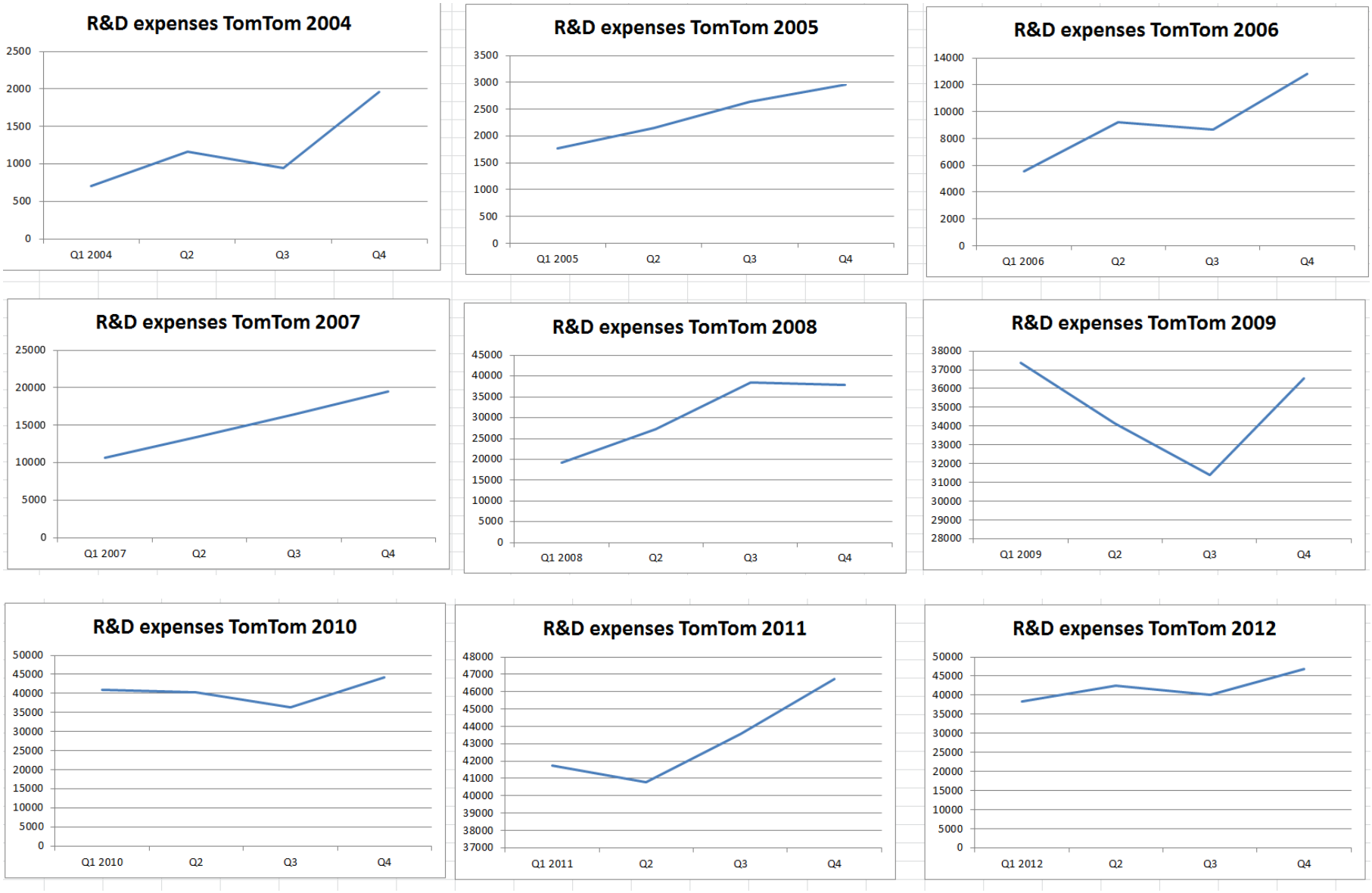
Quarter	q4 2005	q3 2006	q2 2007	q3	q4	q2 2008	q2	q2 2009	q2	q2	q3	q4	q4
Date	1-11-05	1-09-06	20-05-07	30-08-07	12-11-07	1-05-08	1-05-08	1-04-09	1-04-09	1-06-09	28-09-09	1-10-09	1-10-09
Innovation	TomTom ONE	TomTom ONE 2nd edition	TomTom ONE XL	TomTom ONE 3rd edition	TomTom ONE XL HD	TomTom ONE	TomTom ONE XL	TomTom ONE IQ	TomTom XL IQ	TomTom ONE LIVE	TomTom XL 340S LIVE	TomTom XXL 530s	TomTom XXL 540s
Checklist:													
Introduce new generation of products	X	-	-	-	-	-	-				-	-	-
Extend product range	X	-	-	-	-	-	-				-	-	-
Open up new markets	X	-	-	-	-	-	-				-	-	-
Enter new technology fields	-	-	-	-	X	-	-				-	-	-
Radical innovation/exploration?	Radical				Radical								
If not; Improve existing product quality	-	X	X	X	-	X	X	X	X	X	X	X	X
Improve production flexibility	-				-								
Reduce production cost	-				-								
Improve yield or reduce material consumption	-				-								
Incremental innovation/exploitation?	-	Incremental	Incremental	Incremental		Incremental	Incremental	Incremental	Incremental	Incremental	Incremental	Incremental	Incremental
Radical/Exploration = 1, Incremental/Exploitation = 2	1	2	2	2	1	2	2	2	2	2	2	2	2

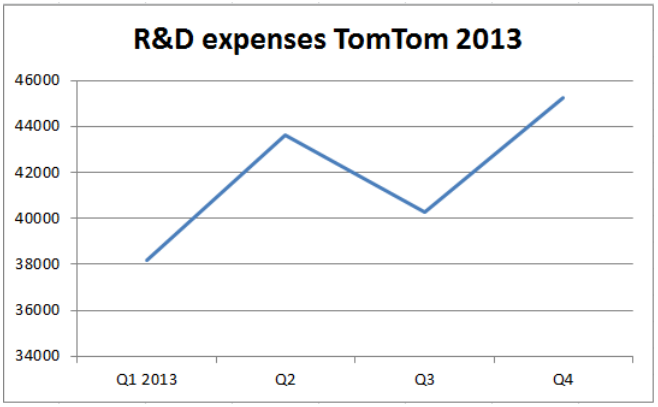
Quarter	q4	q3 2009	q4	q4	q4	q4	q4
Date	29-10-08	3-08-09	1-10-09	1-10-09	1-10-09	1-10-09	1-12-09
Innovation	TomTom GO 940	TomTom GO 9000	TomTom GO 550 LIVE	TomTom GO 750 LIVE	TomTom GO 950 LIVE	TomTom GO 7000 Truck	TomTom GO I-90
Checklist:							
Introduce new generation of products		X	-	-	-	X	X
Extend product range		X	-	-	-	X	X
Open up new markets		X	-	-	-	X	X
Enter new technology fields	X	X	-	-	-	-	X
Radical innovation/exploration?	Radical	Radical				Radical	Radical
If not; Improve existing product quality			X	X	X		
Improve production flexibility							
Reduce production cost							
Improve yield or reduce material consumption							
Incremental innovation/exploitation?			Incremental	Incremental	Incremental		
Radical/Exploration = 1, Incremental/Exploitation = 2	1	1	2	2	2	1	1

Appendix 4: R&D expenses TomTom 2004 t/m 2009 and % change compared with last quarter.

Time	R&D expenses TomTom in € (x1000)	% change
Q1 2004	€ 706,00	
Q2	€ 1.163,00	64,73
Q3	€ 945,00	-18,74
Q4	€ 1.966,00	108,04
Q1 2005	€ 1.764,00	-10,27
Q2	€ 2.151,00	21,94
Q3	€ 2.646,00	23,01
Q4	€ 2.958,00	11,79
Q1 2006	€ 5.566,00	88,17
Q2	€ 9.236,00	65,94
Q3	€ 8.641,00	-6,44
Q4	€ 12.801,00	48,14
Q1 2007	€ 10.680,00	-16,57
Q2	€ 13.507,00	26,47
Q3	€ 16.460,00	21,86
Q4	€ 19.547,00	18,75
Q1 2008	€ 19.132,00	-2,12
Q2	€ 27.163,00	41,98
Q3	€ 38.428,00	41,47
Q4	€ 37.867,00	-1,46
Q1 2009	€ 37.364,00	-1,33
Q2	€ 34.161,00	-8,57
Q3	€ 31.385,00	-8,13
Q4	€ 36.531,00	16,40
Q1 2010	€ 40.965,00	12,14
Q2	€ 40.304,00	-1,61
Q3	€ 36.477,00	-9,50
Q4	€ 44.129,00	20,98
Q1 2011	€ 41.729,00	-5,44
Q2	€ 40.776,00	-2,28
Q3	€ 43.573,00	6,86
Q4	€ 46.745,00	7,28
Q1 2012	€ 38.310,00	-18,04
Q2	€ 42.593,00	11,18
Q3	€ 40.154,00	-5,73
Q4	€ 46.745,00	16,41
Q1 2013	€ 38.181,00	-18,32
Q2	€ 43.627,00	14,26
Q3	€ 40.276,00	-7,68
Q4	€ 45.257,00	12,37

Appendix 5: R&D expenses TomTom per year graphically displayed.

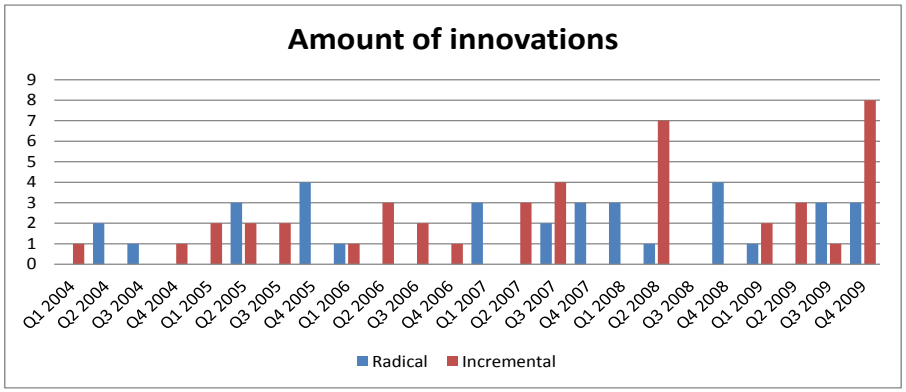


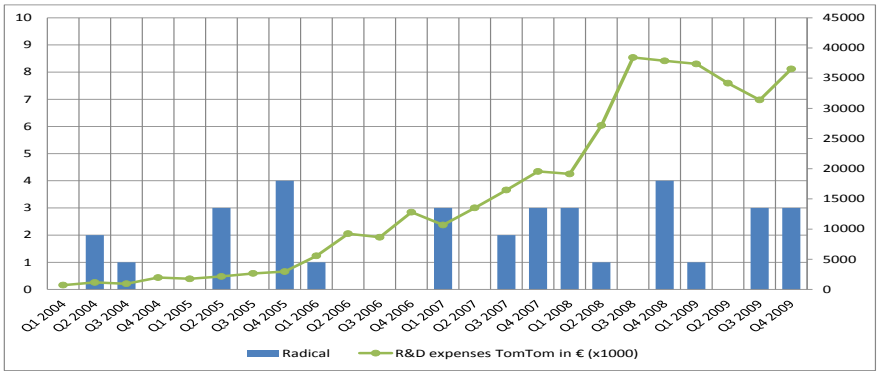


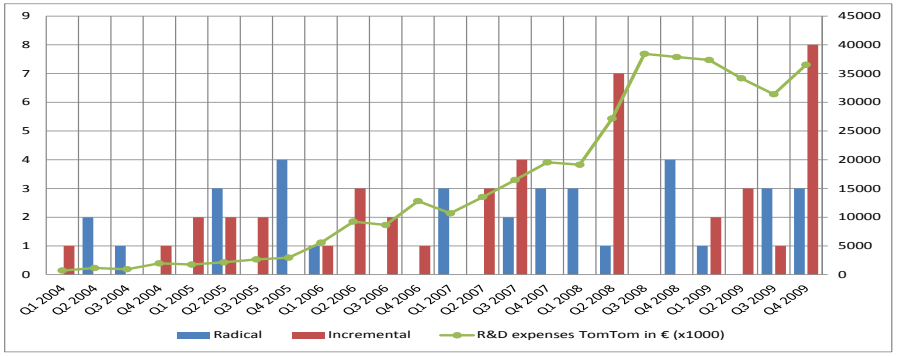
Appendix 6: Linking R&D expenses to the innovations

Year + quarter:	Amount of innovations	Radical	Incremental	R&D expenses TomTom in € (x1000)	% change expenses
Q1 2004	1		1	706	
Q2 2004	2	2		1163	64,73
Q3 2004	1	1		945	-18,74
Q4 2004	1		1	1966	108,04
Q1 2005	2		2	1764	-10,27
Q2 2005	5	3	2	2151	21,94
Q3 2005	2		2	2646	23,01
Q4 2005	4	4		2958	11,79
Q1 2006	2	1	1	5566	88,17
Q2 2006	3		3	9236	65,94
Q3 2006	2		2	8641	-6,44
Q4 2006	1		1	12801	48,14
Q1 2007	3	3		10680	-16,57
Q2 2007	3		3	13507	26,47
Q3 2007	6	2	4	16460	21,86
Q4 2007	3	3		19547	18,75
Q1 2008	3	3		19132	-2,12
Q2 2008	8	1	7	27163	41,98
Q3 2008	0			38428	41,47
Q4 2008	4	4		37867	-1,46
Q1 2009	3	1	2	37364	-1,33
Q2 2009	3		3	34161	-8,57
Q3 2009	4	3	1	31385	-8,13
Q4 2009	11	3	8	36531	16,40

Appendix 7: Number of innovations & R&D expenses







Appendix 8: Linking R&D expenses to all the innovations

Year + quarter:	Amount of innovations	Radical	Incremental	R&D expenses TomTom in € (x1000)	% change expenses	+1 quarter	+2 quarters	+3 quarters	+4 quarters
Q1 2004	1		1	706					
Q2 2004	2	2		1163	64,73				
Q3 2004	1	**1**		945	-18,74	**64,73**			
Q4 2004	1		1	1966	108,04	-18,74	64,73		
Q1 2005	2		2	1764	-10,27	108,04	-18,74	64,73	
Q2 2005	5	**3**	2	2151	21,94	-10,27	**108,04**	-18,74	**64,73**
Q3 2005	2		2	2646	23,01	21,94	-10,27	108,04	-18,74
Q4 2005	4	**4**		2958	11,79	**23,01**	**21,94**	-10,27	**108,04**
Q1 2006	2	**1**	1	5566	88,17	11,79	**23,01**	**21,94**	-10,27
Q2 2006	3		3	9236	65,94	88,17	11,79	23,01	21,94
Q3 2006	2		2	8641	-6,44	65,94	88,17	11,79	23,01
Q4 2006	1		1	12801	48,14	-6,44	65,94	88,17	11,79
Q1 2007	3	**3**		10680	-16,57	**48,14**	-6,44	**65,94**	**88,17**
Q2 2007	3		3	13507	26,47	-16,57	48,14	-6,44	65,94
Q3 2007	6	**2**	4	16460	21,86	**26,47**	-16,57	**48,14**	-6,44
Q4 2007	3	**3**		19547	18,75	**21,86**	**26,47**	-16,57	**48,14**
Q1 2008	3	**3**		19132	-2,12	18,75	**21,86**	**26,47**	-16,57
Q2 2008	8	**1**	**7**	27163	41,98	-2,12	18,75	**21,86**	**26,47**
Q3 2008	0			38428	41,47	41,98	-2,12	18,75	21,86
Q4 2008	4	**4**		37867	-1,46	**41,47**	**41,98**	-2,12	18,75
Q1 2009	3	**1**	2	37364	-1,33	-1,46	**41,47**	**41,98**	-2,12
Q2 2009	3		3	34161	-8,57	-1,33	-1,46	41,47	41,98
Q3 2009	4	3	1	31385	-8,13	-8,57	-1,33	-1,46	41,47
Q4 2009	11	3	8	36531	16,40	-8,13	-8,57	-1,33	-1,46
						16,40	-8,13	-8,57	-1,33
							16,40	-8,13	-8,57
								16,40	-8,13
									16,40
		10 times			Number of bold:	6 times	7 times	6 times	5 times

Appendix 9: Linking R&D expenses to the innovations of TomTom GO range

Year + quarter:	Amount of innovations	Radical	Incremental	R&D expenses TomTom in € (x1000)	% change expenses	+1 quarter	+2 quarters	+3 quarters	+4 quarters
Q1 2004	DNA			706					
Q2 2004	1	1		1163	64,73				
Q3 2004	0			945	-18,74	64,73			
Q4 2004	0			1966	108,04	-18,74	64,73		
Q1 2005	0			1764	-10,27	108,04	-18,74	64,73	
Q2 2005	3	3		2151	21,94	-10,27	**108,04**	-18,74	**64,73**
Q3 2005	0			2646	23,01	21,94	-10,27	108,04	-18,74
Q4 2005	0			2958	11,79	23,01	21,94	-10,27	108,04
Q1 2006	0			5566	88,17	11,79	23,01	21,94	-10,27
Q2 2006	3		3	9236	65,94	88,17	11,79	23,01	21,94
Q3 2006	0		1	8641	-6,44	65,94	88,17	11,79	23,01
Q4 2006	0			12801	48,14	-6,44	65,94	88,17	11,79
Q1 2007	1	1		10680	-16,57	**48,14**	-6,44	**65,94**	**88,17**
Q2 2007	0			13507	26,47	-16,57	48,14	-6,44	65,94
Q3 2007	3		3	16460	21,86	26,47	-16,57	48,14	-6,44
Q4 2007	0			19547	18,75	21,86	26,47	-16,57	48,14
Q1 2008	0			19132	-2,12	18,75	21,86	26,47	-16,57
Q2 2008	3		3	27163	41,98	-2,12	18,75	21,86	26,47
Q3 2008	0			38428	41,47	41,98	-2,12	18,75	21,86
Q4 2008	3	3		37867	-1,46	**41,47**	**41,98**	-2,12	18,75
Q1 2009	0			37364	-1,33	-1,46	41,47	41,98	-2,12
Q2 2009	0			34161	-8,57	-1,33	-1,46	41,47	41,98
Q3 2009	1			31385	-8,13	-8,57	-1,33	-1,46	41,47
Q4 2009	5	2	3	36531	16,40	-8,13	-8,57	-1,33	-1,46
Total	23	10	10			16,40	-8,13	-8,57	-1,33
							16,40	-8,13	-8,57
								16,40	-8,13
									16,40
					Number of bold:	**2**	**2**	**1**	**2**

Appendix 10: Linking R&D expenses to the innovations of TomTom ONE range

Year + quarter:	Amount of innovations	Radical	Incremental	R&D expenses TomTom in € (x1000)	% change expenses	+1 quarter	+2 quarters	+3 quarters	+4 quarters
Q1 2004	DNA			706					
Q2 2004	DNA			1163	64,73				
Q3 2004	DNA			945	-18,74	64,73			
Q4 2004	DNA			1966	108,04	-18,74	64,73		
Q1 2005	DNA			1764	-10,27	108,04	-18,74	64,73	
Q2 2005	DNA			2151	21,94	-10,27	108,04	-18,74	64,73
Q3 2005	DNA			2646	23,01	21,94	-10,27	108,04	-18,74
Q4 2005	1	1		2958	11,79	**23,01**	**21,94**	-10,27	**108,04**
Q1 2006	0			5566	88,17	11,79	23,01	21,94	-10,27
Q2 2006	0			9236	65,94	88,17	11,79	23,01	21,94
Q3 2006	1		1	8641	-6,44	65,94	88,17	11,79	23,01
Q4 2006	0			12801	48,14	-6,44	65,94	88,17	11,79
Q1 2007	0			10680	-16,57	48,14	-6,44	65,94	88,17
Q2 2007	1		1	13507	26,47	-16,57	48,14	-6,44	65,94
Q3 2007	1		1	16460	21,86	26,47	-16,57	48,14	-6,44
Q4 2007	1	1		19547	18,75	**21,86**	26,47	-16,57	48,14
Q1 2008	0			19132	-2,12	18,75	21,86	26,47	-16,57
Q2 2008	2		2	27163	41,98	-2,12	18,75	21,86	26,47
Q3 2008	0			38428	41,47	41,98	-2,12	18,75	21,86
Q4 2008	0			37867	-1,46	41,47	41,98	-2,12	18,75
Q1 2009	0			37364	-1,33	-1,46	41,47	41,98	-2,12
Q2 2009	3		3	34161	-8,57	-1,33	-1,46	41,47	41,98
Q3 2009	1		1	31385	-8,13	-8,57	-1,33	-1,46	41,47
Q4 2009	2		2	36531	16,40	-8,13	-8,57	-1,33	-1,46
Total	13	2	11			16,40	-8,13	-8,57	-1,33
							16,40	-8,13	-8,57
								16,40	-8,13
									16,40
					Number of bold:	**2**	**1**	**0**	**1**