

Are US innovative companies really process innovative?¹

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Abstract. The result of knowledge management should be the permanent innovational process and implementation of intensive development factors. It is thus useful to dispose of sufficiently universal, practicable, and well-interpretable quality analysis how successful an innovation is. The paper suggests the methodology for evaluating process and organizational innovation that does not require great amount of information and as the output gives the value of dynamic intensity and extensity parameter. The proposed methodology has been applied to the development analysis of the company Nike and comparison of 7 prominent companies of the United States that are seen as innovative ones. Our analysis however shows that development most of them are based on the extensive factors.

1 Introduction

A successful firm innovates and the presence of innovation should be one of confirmation that we really can speak about knowledge management economy. But how it is possible to recognize whether an innovation was viable? The answer, of course, depends on the type of innovation and must be emphasized that there is no unique definition of innovation. We agree with opinion declared in OECD (2010) that all innovation must contain a degree of novelty. The Oslo Manual for measuring innovation (OECD 2005) defines four types of innovation: product innovation, process innovation, marketing innovation and organizational innovation. The paper concentrates especially on the process innovation and partially on the organizational innovation² on the enterprise level, which aim to increase the growth rate of a firm's output more than the growth rate of its inputs. We suggest simply mathematic method how to measure success of innovation in terms intensity and extensity. Generally, if a firm wants to increase its production, it has two pure ways: 1. So-called extensive growth³: it only increases its inputs without any innovation or technological progress; 2. So-called intensive growth: It innovates and increases output without any growth of inputs. Real development usually contains some combination of extensive and intensive growth. Firms can also compensate extensive factors for intensive or, alternatively, intensive factors for extensive without change of its production. In the case of firm's output decline, a firm should know whether this only occurs due to the fall of extensive or intensive factors or if falls of both factors contribute to output decline and how much. Both factors can further change in opposite direction with different growth rate (e.g. extensive factors can grow more than extensive factors decline) and so can affect the final change of production. All situations are useful to measure and express the share of the change of

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² OECD (2005) defines process innovation as: “a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.” Organizational innovation is defined as “a new organizational method in business practices, workplace organization or external relations.”

³ E.g. Senhadji (1999).

intensive and extensive factors on the change of the output. The knowledge is useful for strategic and other management decision-makings.

The method presenting in the paper deals with all possible combinations of extensive and intensive changes and so it differs from the growth accounting equation that may only be used in case of output growth⁴. The paper is organized as follows: The first chapter introduces the method; the second one applies it to the company Nike that was announced as the most innovative company of 2013 by the business journal Fast Company. The chapter investigates whether the performance of Nike really relies on intensive factors. The chapter also compares the performance of Nike with the performance of some other companies that are, from the point of view of Fast Company journal, among the first thirty most innovative companies of 2013.

2 Methodology of the analysis of the intensive and extensive development

One of the most elementary methods of describing the behavior of any system is the monitoring of its output and corresponding inputs. This cybernetic perspective may be carried out for companies as follows: we select total revenue⁵ TR_0 as the output for the given base period (index 0), with total costs TC_0 corresponding to inputs. The difference of the two values represents profit:

$$\Pi_0 = TR_0 - TC_0 \quad (1)$$

The quotient of TR_0 and TC_0 equals to efficiency Ef_0 , which represents⁶ the share of total revenue derived from each unit (expressed in some currency) of invested costs.

$$Ef_0 = TR_0 / TC_0 \quad (2)$$

In order to monitor the development of a company in time, it is necessary to apply dynamic characteristics, e.g. for the total revenue:

$$\text{- Absolute increment } \Delta(TR) = TR_1 - TR_0 \quad (3)$$

$$\text{- Growth rate } G(TR) = (\Delta(TR))/TR_0 \quad (4)$$

$$\text{- Change coefficient } I(TR) = TR_1/TR_0 = G(TR) + 1 \quad (5)$$

Statement (2) may be used to derive a dynamic statement for the development of total revenue:

$$I(TR) = I(Ef) \cdot I(TC) \quad (6)$$

If we wish to calculate how the development of intensive (qualitative) factors represented by $I(Ef)$ and extensive (quantitative) factors represented by $I(TC)$ shares on the development of total revenue $I(TR)$, it is first necessary to use logarithmic calculation for statement (6).

$$\ln I(TR) = \ln I(Ef) + \ln I(TC) \quad (7)$$

⁴ For growth accounting, see e.g. Solow (1957).

⁵ The following applies to both values: $TR \geq 0$ and $TC \geq 0$. In case $TR \leq TC$, profit will be less than or equal to zero ($EP \leq 0$).

⁶ We use one of the standard definitions of efficiency. E. g. in Webster's New World College Dictionary (2010) is: written: "The ratio of the effective or useful output to the total input in any system."

Statement (7) is the initial statement for deriving dynamic intensity and extensity parameters. These parameters⁷ have the following form. Dynamic intensity parameter:

$$i = \frac{\ln I(Ef)}{|\ln I(Ef)| + |\ln I(TC)|} \quad (8)$$

And supplementary dynamic extensity parameter:

$$e = \frac{\ln I(TC)}{|\ln I(Ef)| + |\ln I(TC)|} \quad (9)$$

Statements (8) and (9) respect all possible developments of the share of extensive and intensive factors (Mihola 2007, p. 125):

- Change in the extensive factors only, without any change in the intensive factors;
- Change in the intensive factors only, without any change in the extensive factors;
- Simultaneous growth of both extensive and intensive factors;
- Simultaneous decline of both extensive and intensive factors;
- Compensation of extensive factors for intensive factors;
- Compensation of intensive factors for extensive factors;
- Stagnation of both extensive and intensive factors.

3 Analysis of development of intensive and extensive factors for Nike

Each year, the American journal Fast Company announces the ranking of the most innovative companies in the world – the results are published on the magazine website www.fastcompany.com. The presence of intensive factors may be assumed for innovative companies as a confirmation of knowledge management functioning. To find out whether this is in fact true, we applied the methods described in Chapter 1 to the most innovative company of 2013, Nike. Moreover, the results for Nike were compared with the results of 6 other companies (Amazon, Apple, Coca Cola, Google, Ford Motor, and Target)⁸, which ranked by Fast Company journal in the top 30 of the most innovative companies of 2013. The analysis was carried out for the period of 1995-2011 (with the last known economic results available for individual companies for 2011) – the period of 17 years is long enough to make a qualified assessment whether intensive or extensive factors prevail for Nike and other compared companies. Therefore, the comparison includes companies that existed throughout the term under review⁹. Consequently, other innovative companies (e.g. those that ranked in the Top 10 of the most innovative companies in 2013 according to the Fast Company journal) were not included in the comparison due to their short-term existence. The values of the intensity/extensity parameters for those companies could be biased by accidental fluctuations of total revenue or costs in individual years.

⁷ The properties of these parameters are examined in detail in Hájek and Mihola (2009) or in Cyhelský, Mihola and Wawrosz (2012).

⁸ Input data for the analysis, i.e. total revenue (TR), total costs (TC), and profit (II), for Apple, Coca Cola, Ford, Nike, and Target have been taken from <http://money.cnn.com/magazines/fortune/fortune500/>; data for Amazon have been taken from the company's annual reports available at <http://http://phx.corporate-ir.net>; data for Google have been taken from <http://http://investor.google.com/earnings.html>.

⁹ Google is the only exception, as data for the company are only available from 2001.

Tab. 1 contains year-to-year growth rates of total revenue G(TR) and total costs G(TC) for Nike in the period of 1995 - 2011. Furthermore, we also provide the calculated values of efficiency growth rates G(Ef) and dynamic parameters relating to the share of influence of intensive factors i and extensive factors e for the given period.

Tab. 1: **Dynamic characteristics of Nike**

	1996/5	1997/6	1998/7	1999/8	2000/9	2001/0	2002/1	2003/2	2004/3	2005/4	2006/5	2007/6	2008/7	2009/8	2010/9	2011/0	2011/5
G(TR)	36%	42%	4%	-8%	2%	5%	4%	8%	15%	12%	9%	9%	14%	3%	-1%	9%	9,6%
G(TC)	36%	42%	9%	-9%	1%	6%	4%	11%	11%	11%	8%	9%	13%	6%	-3%	6%	9,3%
G(Ef)	0%	0%	-5%	1%	1%	0%	1%	-2%	4%	1%	1%	0%	1%	-3%	3%	3%	0,3%
i	1%	0%	-35%	10%	56%	-4%	13%	-19%	26%	10%	6%	-2%	8%	-32%	43%	32%	3%
e	99%	100%	65%	-90%	44%	96%	87%	81%	74%	90%	94%	98%	92%	68%	-57%	68%	97%

Source: TR and TC were taken/calculated from <http://money.cnn.com/magazines/fortune/fortune500/>. Statements (5) and (6) were used to calculate G(TR), G(TC), G(Ef); statements (8) and (9) were used to calculate the values of the dynamic parameters intensity (i) and extensity (e).

The tab. 1 shows that Nike attained the highest TR growth rates of around 40% in the first two years of the observed period¹⁰ - 1996 and 1997 – as a result of a pure extensive development, when $e = 99$ and 100%, respectively. The year of crisis (1998) follows, with a weak TR growth of 4% and extensive compensation of $i = -35\%$ and $e = 65\%$. In 1999, TR declines by 8%, with significantly predominant negative extensity $e = -90\%$ and $i = 10\%$. In 1998, the company was affected by the Asian crisis and this was the key reason for the higher growth rate of costs compared to revenue. The company reacted to the given developments in 1999 by reducing its costs; however, the consequences of the crisis also resulted in the fall of revenue. Next year the revenue again increased; the growth resulted from and intensively-extensive growth ($i = 56\%$, $e = 44\%$). During the given year, the highest share of influence of intensive factors was achieved for the entire period under review. The period of 2001 - 2008 were characterized by gradual increase in the TR growth rate to up to 15% whereas the minimal value of the TR growth rate amounted to respectable 8% (2003). The extensive development dominated in all cases, ranging from 74% to 98%. The intensity amounted to -19% to 26%. The causes for the negative value of i were as follows¹¹:

- In 2001, problems with the sale of low-price and medium-price goods in the US;
- In 2003, higher growth rate of TC compared to the TR growth rate; the higher growth of costs resulted from the USD appreciation;
- In 2007, slightly higher growth rate of costs compared to the growth rate of revenue.

In the period of 2009 – 2010, the situation of the period 1998 – 1999 virtually recurs in terms of the influence of intensive factors. In 2009, the company was affected by the global financial and economic crisis, with resulting decrease in the revenue growth rate – i.e. revenue growth lagged behind the increase in costs. The company reacted to the given situation by reducing costs; however, the consequences of the crisis still persisted, which was reflected in a slight decline of revenue. The year 2011 indicates returns to the positive development but it must be validated by results for following years.

¹⁰ Fiscal year of Nike starts on 1 June and ends on 31 May. For example, the year of 1996 covers period from 1 June 1995 to 31 May 1996.

¹¹ The causal analysis is based on the Nike's annual reports for the years under review.

The last column of tab. 1 shows that the contribution of intensive factors to the average year-to-year revenue growth rate of 9.6% in the observed period only amounted to 3%, with 97% contribution arising from extensive factors for the entire period under review¹². In the given period, the growth of Nike was almost purely extensive. In terms of process and organizational innovations, it can be concluded that the company recorded only a minor advancement in the given field. This does not mean the company was not successful in terms of product and marketing innovations. However, it is very disputable to say whether Nike meets one of the generally characteristic properties of innovations – i.e. reduction of costs and increasing output.

Nike produces almost all of its products outside of the US, while the US market contributes to more than 40% of revenue on a long-term basis (43% in 2011). Nike can bank on the cheap and available labor force what is probably the main reason of the low value of intensity parameter (*i*) - Nike can easily increase its production by increasing its inputs and so costs without higher share of intensive factors. Present favorable condition of production, however, could change. Nike seems to be the vulnerable company from the point of view of our analysis. If the growth rate of Nike's cost suddenly exceeds the growth rate of its revenue due to a crisis Nike has little possibilities how to respond. Both Asian crisis (year 1998) and global financial and economic crisis (year 2009) have same pattern: unexpected growth of costs followed by company effort to push it down. The effort was in short period only partial successful. Drop in the cost was always accompanied by decline of the revenue. Although the company performance stabilized at least two years after the start of the mentioned difficulties s it is not sure whether the company would be able to solve some enormous growth of cost in the case of large problems. The development of the company's costs is clearly affected by the development of the USD exchange rate to the currencies of countries where Nike produces its goods. If USD appreciates for long period, reduction of the cost could be insufficient. The process and organizational innovation seems then to be the best answer how to offset the growth of cost caused by appreciation. From our point of view the company should target process and organizational innovations more – these innovation could be seen as one of Nike's new strategies. Knowledge management should pay process innovation greater attention.

Let us now turn our attention to the comparison of average values of growth rates $G(TR)$, $G(TC)$ and $G(Ef)$ as well as average values of the intensity parameter *i* and extensity parameter *e* for Nike with other innovative American companies. The average year-to-year growth rates and dynamic parameters for all companies and the entire period in Tab. 2 are sorted in the same manner as in Tab. 1; however, they are completed with annual average values of absolute data TR, EP, TC, and Ef.

Tab. 2: Base data of the comparative analysis of seven US companies

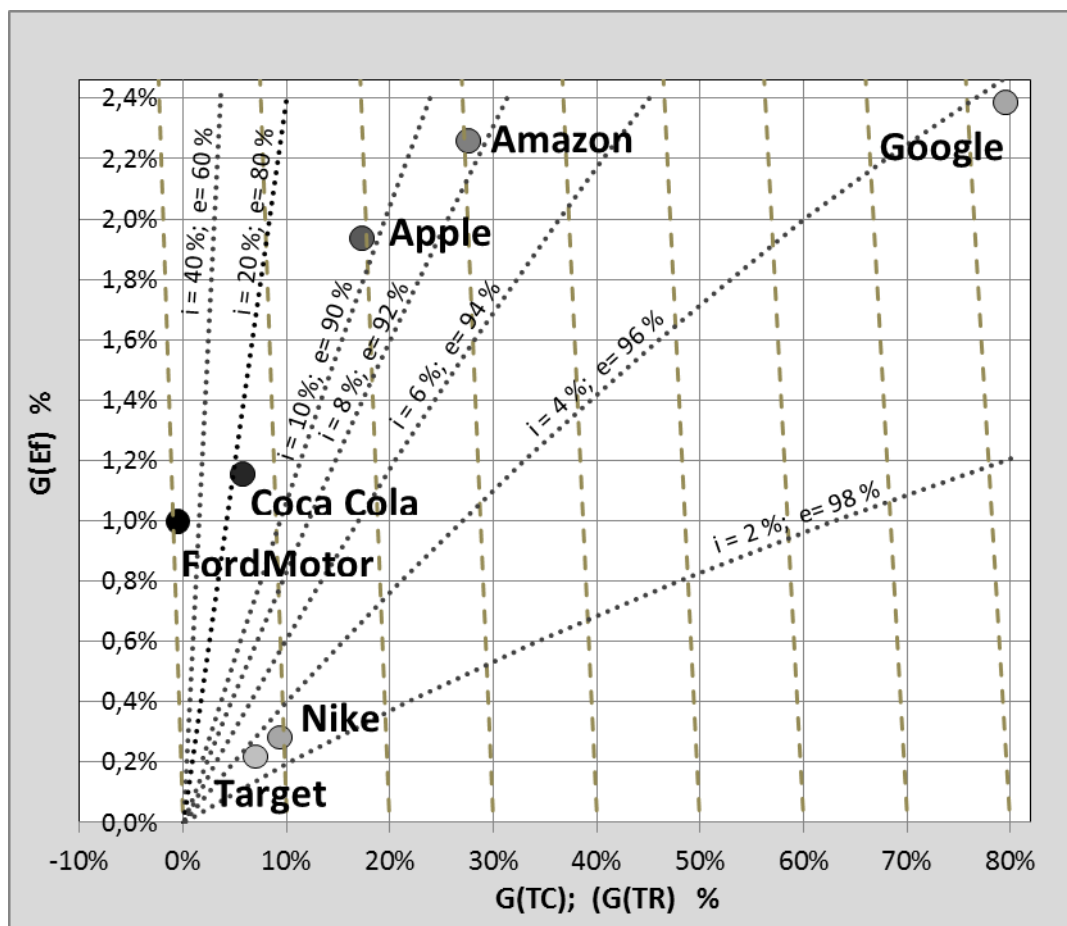
	1995 – 2011						
Indicator	Ama zon	Goog le	Appl e	Ford Motor	Nike	Target	Coca Cola
TR (mil.\$)	13 116	13 744	21 966	154 571	12 516	47 243	24 596
EP (mil. \$)	363	5 161	3 408	2 784	1 021	1 854	4 854
TC (mil. \$)	12 752	8 583	18 558	151 786	11 495	45 389	19 742

¹² All values in the last column of tab. 1 were counted as the geometric mean previous columns in the given row.

$E_f = TR/TC$	1.028	1.601	1.184	1.018	1.089	1.041	1.246
$G(TR)$	30%	84%	20%	0,5%	10%	7%	7%
$G(TC)$	28%	80%	17%	-0,5%	9%	7%	6%
$G(E_f)$	2%	2%	2%	1%	0%	0%	1%
i	8%	4%	11%	67%	3%	3%	17%
e	92%	96%	89%	-33%	97%	97%	83%

Source: TR / EP values were calculated using statements (1) and (2) from the data provided in Note 6. Statements (5) and (6) were used to calculate $G(E_f)$; statements (8) and (9) were used to calculate the values of the dynamic parameters intensity (i) and extensity (e).

Fig. 1: Comparison of the dynamics intensity for seven US companies



The results of the comparison are shown in Fig. 1, with growth rate of total costs on the horizontal axis and efficiency growth rate $G(E_f)$ on the vertical axis. The parallel isoquants $G(TR)$, shown in a dashed line, also start from the horizontal axis for the given percentage values. The isoquants are derived on the basis of statement (6) and shows all value of $G(TC)$ and $G(E_f)$ the product of which gives the same value of $G(TR)$. The bundle of curves starting from the origin represents isoquants of constant values of dynamic intensity/extensity parameters – these isoquants represent all values of $G(E_f)$ and $G(TC)$ given by the relevant values of parameters i and e in statements (8) and (9). For example, the lowermost isoquant ($i = 2\%$, $e = 98\%$) shows all values of $G(E_f)$ and $G(TC)$, for which $i = 2\%$ in statement (8) and $e = 98\%$ in statement (9).

It is apparent from the chart that the highest average growth rate $G(TR)$ of 84% is recorded by Google, followed in the distance by Amazon (30%), Apple (20%), Nike (10%), Target and Coca Cola (7%), with Ford Motor coming in last (mere 0.5%). However, the order is very different in terms of the development of the intensity and extensity parameters (value i and e in the last two rows of the tab. 2). The year-to-year growth of Ford Motor was mainly attained through intensive factors. This is an intensive compensation, where intensity of 67% compensates negative extensity of -33%. It could be written that Ford Motor must innovate and employ intensive factors. The company faces huge costs due to expensive labor force. If it reduces the number of employees with the aim to reduce costs and wants to keep or to increase its production an innovation is necessary consequence. The development was mainly extensive in all the remaining companies. The second highest intensity is recorded by Coca Cola (17%), followed by Apple (11%), Amazon (8%), and Google, Nike and Target with intensity of 4% or 3%.

4 Conclusions

The article shows how time series of the basic company indicators (total revenue, total costs, and profit) may be used to analyze, whether the change in such indicators in time is caused by mainly extensive factors, reflecting the change of company inputs, or by mainly intensive factors, with changes in the efficiency indicator. Furthermore, the article has revealed that even the development of companies announced as the most innovative by Fast Company journal relies mainly on extensive factors – the total revenue growth rate predominantly results from increasing total costs. We are aware of the fact that other factors may also affect the development of costs in a year-to-year comparison – e.g. in the form of USD appreciation and thereby rising input prices – however, intensive factors should come to light in a long-term development covering 17 years. Even the most innovative company of 2013 according to the Fast Company journal, Nike, developed mainly extensively in the period of 1995 - 2011. Paradoxically, the highest intensive development was recorded by a member of the traditional car manufacturing sector, Ford Motor, which was able to benefit from the application of intensive factors and compensate the declining total costs. Naturally, innovative companies also innovate in the area of quality of their products, marketing, etc. Nevertheless, process and organizational innovations should not be left aside. From our point of view observed companies should pay more attention to intensive factors of their development and may achieve significant improvements in this area.

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