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New Product Introduction: Does the Highest Growth Create a Competitive Advantage?

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ABSTRACT

In today's markets managers are focused on growth and profits. This could affect negatively on the other important competitive characteristics, such as investments and working capital. Financial literature supports this opinion, according to it cash flow measure will reveal all these hidden problems. For example, nowadays inventories are seen more like a liability than asset, at least in the very volatile business environment (shorter product life-cycles and higher product variety). Total productivity should also be perfect measure for this kind of fast changing environment; it does not only consider traditional input items such as human, materials, fixed capital, energy and other expenses. But it will take also into account working capital.

In this paper, we demonstrate two hypothetical situations, where growth estimates will be exceeded remarkably with introduced new product family. According to the growth and profit performance measures, the highest growth scenario is the most profitable in both situations. However, the lack of manufacturing capacity and limited length of product life-cycle will generate problems. According to the analyses, the highest, and also the least volatile total productivity development was achieved in the lower growing scenarios. Cash flow analyses will reveal the same, higher growth will give its benefits after investment, but the differences are rather marginal. In the end of the product life-cycle lower growing scenarios will produce significantly better cash flow. According to the results of this paper, the high growth is important performance measure and affordable, but it has its limitations. The real differences will be found from the discounted cash flow of the whole product life-cycle.

KEYWORDS: New product introduction, investments, growth, cash flow and total productivity

1. INTRODUCTION

Almost in every industry product life cycles have shortened dramatically, and effects of product variety and innovation have been noted to have impressive effect on profitability performance. Most often growth of sales is ranked as primary indicator of success, among simple profit (e.g. EBIT and EPS) and efficiency measures (e.g. inventory turns and capacity utilization). In some occasions these measures have been ranked more important than proper cash flow performance. Another indicator of longer term success, total productivity, has almost perfectly been forgotten. The one responsible factor for this is the available amount of free money in the capital markets – with initial public offerings even small but growing companies could gather large amount of capital for their operations. So these companies do not instantly need to consider cash flow, profits or efficiency of the whole capital.

This paper tries to focus on the number of different aspects: general competitiveness, manufacturing strategy and product development. Firstly we will introduce total productivity measurement techniques, and there after in the empirical part two hypothetical examples from new product introduction process are given. Total productivity, profits, inventory turns and cash flow performance are analyzed, when manufacturer will face remarkable exceeding in estimated sales. So the scope of investment and capacity requirements were planned with much more lower growing scenario. These higher growing scenarios will face their limits, and working capital will increase tremendously. We will demonstrate that this will have significant impact on total productivity and cash flow. However, growth rates in the earlier parts of product life-cycle as well as profitability during the entire life-cycle will not give negative indications. The measurement of inventory turns will give some valid indications, but significant differences could be found as compared to the total productivity measurement. These differences in performance will widen, if high growth rates are combined with accelerated investments.

2. TOTAL PRODUCTIVITY

The traditional definition of productivity has a variety of different interpretations. Often productivity has been associated with productivity of labor, but according to total productivity models, labor is only one input parameter. Other input items are most often tied towards profit and loss calculation or cost accounting principles (Davis 1955). Traditionally in total productivity models total output is not units sold, but units produced – productivity is about converting efficiently inputs to outputs (Craig & Harris 1973: 16; Sumanth 1979: 6.5). The idea behind total productivity measurement at the firm level was presented first by Craig et al. (1973) (see Equation 1.). However, according to Pineda (1990: 1-16, 36-77) some authors have written about total productivity earlier (e.g. Davis 1955; Kendrick 1984). Also Sumanth (1979, 1998) describes same kind total productivity formula as Craig et al. (1973), but excludes from Q item energy expenses (see Equation 2.). There could be found minor differences between two different presented models in the definition of output. Differences are not so significant, because Craig et al. (1973) also mentioned in their article dividends from securities, interest from bonds and interest from other similar sources as belonging to the group of output.

Equation 1. Total productivity formula (Craig et al. 1973).

$$P_t = \frac{O_t}{L_t + C_t + R_t + Q_t}$$

where P_t is total productivity, L_t labor input factor, C_t capital input factor, R_t raw material and purchased parts input factor, Q_t collection of smaller another input factors, which are not included in previous ones, O_t total output.

Equation 2. Total productivity formula (Sumanth 1979: 4.1-4.3, 1998: 63-110, 391-393).

$$\text{Total Productivity} = \frac{\text{Total Tangible Output}}{\text{Total Tangible Input}}$$

$$\text{Total Productivity} = \frac{O_1 + O_2 + O_3 + O_4 + O_5}{H + M + FC + WC + E + X}$$

where O_1 is finished units completed (for sale and internal use), O_2 partial units completed (for sale and internal use), O_3 dividends from securities, O_4 interest from bonds, O_5 other income, H human input, M materials input, FC fixed capital input, WC working capital input, E energy input, X other expenses input

Labor or human input in both models include monetary input of all workers: blue-collar, managers, professionals and clerical staff. Fixed capital input (Equation 1., one part of the capital input) contains mainly land, plant (buildings and structures), machinery, tools and other equipment expenses. Working capital (Equation 1., second part of the capital input) takes on the account current assets, which in productivity models include inventories, cash, accounts receivable, notes receivable and other receivables. Materials or purchases include purchases in general, for example raw materials and purchased parts. Outside services (e.g. cleaning, consultation, subcontracting of production) should be included in the group of other expenses inputs. These also include travel, taxes, professional fees, office supplies, R&D and general administration expenses. If input item is not labor, purchase, capital, then it has to belong to other expenses. However, Sumanth excludes from the input of other expenses energy input, which contains oil, gas, coal, water and electricity. This excluding might be useful in industries, where energy input is representing significant part from total input. (Craig et al. 1973; Sumanth 1998: 68)

3. PERFORMANCE AFTER NEW PRODUCT INTRODUCTION, HYPOTHETICAL EXAMPLE

A manufacturing company, operating in the electronics industry (industrial products) has developed new product family to replace its older ones. According to completed marketing studies the maturity phase with this introduced product family will be reached within five years and estimated market size is then $100 million. However, older production machinery and testing equipment could not be used with this new product, because the technical quality requirements are much more higher and used technology differs quite a much. For this reason total investment will be moderately high, $22 million. Absolute amount of fixed capital will be estimated in the manufacturing company with cumulative depreciation method, 30 percent per year.[1] Materials input is assumed to stay within the same levels during the five year period, changing proportionately with supplied output: so when maturity phase is reached material costs will be $27.5 million. On the working capital input there are only included inventories, not any receivables or payables. This input item will develop similarly with materials input (productivity will be the same), but after the maximum capacity has been reached (output $100 million) all the extra orders will be included on the order backlog (appreciated only for material value[2]). The two remaining input items, other expenses and direct labour are assumed to be fixed. The former will include the inputs of indirect workers as well as indirect supplies, and the total amount per year is $9.9 million. Direct labour is quite well trained and transaction costs (hiring and firing) for achieving flexibility benefits would be too high. So the total amount per year is fixed with this input item, $7.7 million.

Even if the new product introduction with estimated parameters given above will yield negative total cash flow during the five year period, it is seen more like a timing option (Hertz 1968; Lessard 1986). Organization expects, that this introduced product family has potential also for higher total market size than was originally estimated. Because of this six ”more than estimated” growth scenarios for manufacturing unit were observed. All of these will exceed the estimated market size significantly (achievable with 15 percent yearly growth): The lowest scenario (25 percent yearly growth) will have twice as big and highest scenario (35 percent

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[1] Historic cost depreciation method is not emphasized within classical studies. Both Sumanth (1979: 6.9.) and Craig et al. (1973) used lease value of fixed capital. Also Stainer’s (1997) empirical research results suggest similarly, because replacement costs were most frequently used to value fixed capital input item (in European countries).

yearly growth) three and half times bigger market size. According to Alahuhta (1990) lead customer strategy (*"technology pull"*) will provide proper circumstances for ”more than estimated” increases. Unlikely this kind of development is not so uncommon in electronics industry (The MIT Commission on Industrial Productivity 1990: 13): For example, Micron Technology which operates in semiconductor industry, had totally $5 million as revenues in 1982, but two years later and after initial public offering (IPO) it recorded as high as $117 million. It is good to note that one year later from this Micron's revenues dramatically decreased to $36 million. However, in 1990's its performance has not been so volatile, according to one study it was holding position of the most total productive company in the U.S. between four year period 1993-1996 (Takala, Hilmola, Helo, Sumanth & Generalis 1999). From the pharmaceutical industry could be found described extreme examples also: Only a very low number of products could generate all the income, and then product development is long and very selective (Ravenscraft & Long 2000).

Figure 1. presents the total productivity development of six different growth scenarios (see Appendix A). Three highest growing scenarios will face difficulties firstly, because manufacturing process is not enable to respond market demand. It is interesting to note, that the lowest growth scenario is able to reach its maximum performance of the whole group, even with low volatility. The second lowest growth scenario is not performing poorly either. It should be no surprise that these two lowest growing scenarios achieve the highest total productivity in the final period too. How achievable is it to have higher growth rates? Or are lower rates better? According to simple profit and loss calculation the highest increasing scenario should be the most profitable (see Appendix B). As could be noted from the Figure 2., this growth scenario does not produce any losses during its entire life-cycle. However, total productivity analyses quite clearly indicated that the lowest and second lowest growth scenario will have most impressive performance in terms of total productivity performance. Collision of these two different analyses is quite fundamental. Which one is better?[3]

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[2] Often also direct labour costs are included on the inventory value. With Activity Based Costing (Kaplan 1995) other relatively fixed costs are added with drivers to inventory. Sometimes this might be beneficial for financial performance, profits could be increased remarkably with ever increasing inventory.

[3] Total productivity approach will also produce different solutions for product mix problems (Nandkeolyar & Christy 1989). However, available capacity in manufacturing process and volume dependency of different input items will decide how profitable proposed product mix really is (Goldratt 1990; Corbett 1998).

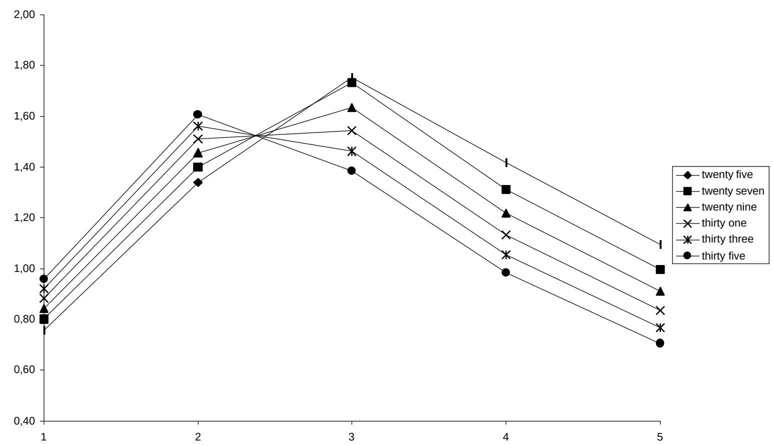

Figure 1. Total productivity development during estimated life-cycle.

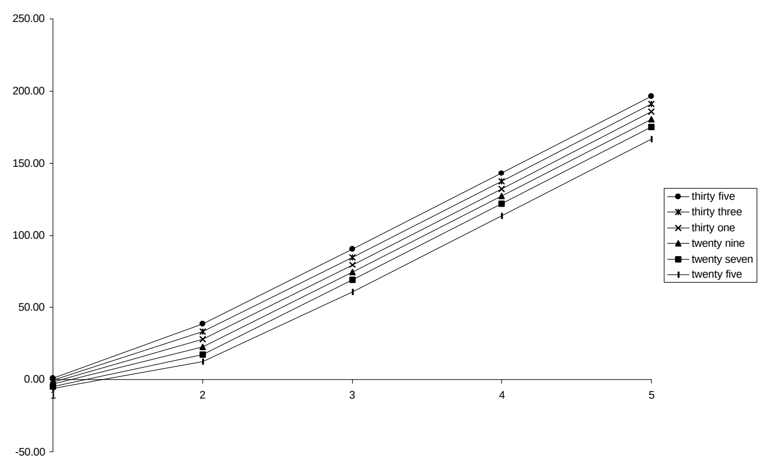

Figure 2. Cumulative profits during estimated life-cycle.

Inventory turns with different growth scenarios are shown in the Figure 3 (see Appendix C). As could be noticed, when there is enough capacity to fulfill demand, performance is slightly above 3.5. However, when the remarkably growing demand will be added to the constrained manufacturing process, problems will arise. The highest growing scenario will record the most dramatic decline (could be named as a free fall): During the third period it will have manufacturing lead time over 10 months (increase over 200 percent!). However, the lowest growing scenario will face similar decline only one period after. Also the second highest and the second lowest will have quite dramatic decline. Firstly mentioned will face it during the third period and latter in the fourth period. According to the Figure 3., only growth rates of 29 and 31 percent will have the most stabile decrease (in given order). The results are totally different as compared to total productivity analysis, even if the most changing partial productivity (working capital) is only further analyzed. It should also be noted, that other input items are in the given hypothetical model near to the ideal environment, which is quite rare to be found from the practice. So according to this, it could be concluded that simple profit and loss calculations enhanced with inventory turns performance is not substitute for total productivity performance measurement.

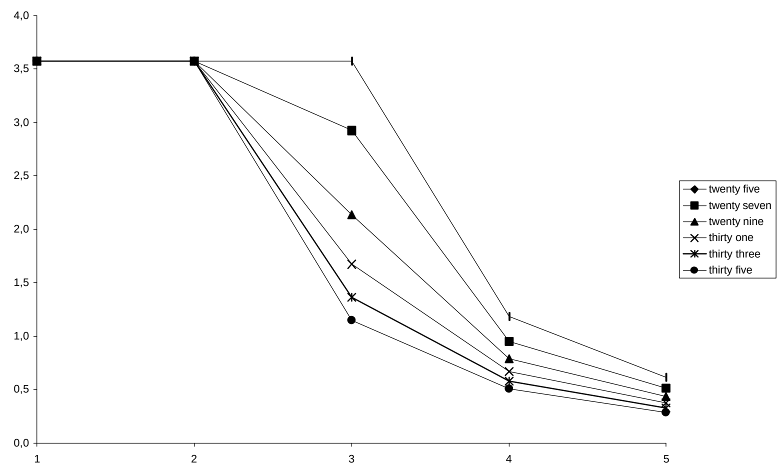

Figure 3. Development of inventory turns during estimated life-cycle.

Measurement of cash flow performance will give additional insights for this problem. According to Figure 4. significant investment will have the lowest impact on cash flow with the highest growing scenario (see Appendix C). As could be assumed in the first place, differences are not so remarkable. However, during the third and fourth period all of the different scenarios will face difficulties. Especially two highest growing ones will have significant decline, and during the final period both of them will generate lower cash flow than in the second period. It should be noted, that the second lowest growth scenario will generate highest cash flow from the whole group during the third period (discounted with 10 % p.a.). Also after discounting (10 % p.a.) cash flows from all different growth options during their entire life-cycle, could be found that highest DCF is achieved within the second lowest growing scenario. In contrary lowest DCF is produced in the highest growing. It should be noted, that discounted cash flows in all groups had positive values. However, the highest cash flow achieved with 27 percent yearly growth had about 15 percent higher absolute value than the lowest one.

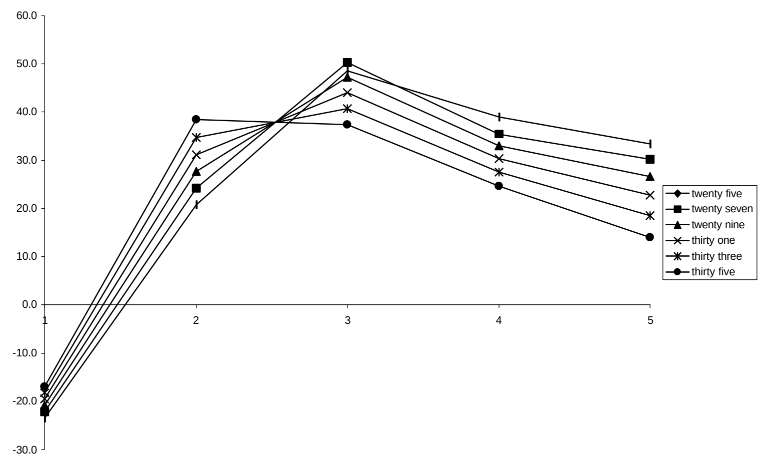

Figure 4. Cash flow development during estimated life-cycle.

4. PERFORMANCE AFTER NEW PRODUCT INTRODUCTION USING REACTIVE CAPACITY EXPANSION, HYPOTHETICAL EXAMPLE

In investment literature (Hertz 1968; Gupta & Rosenhead 1968; Brealey & Myers 1984: 450-455; Amram & Kulatilaka 1999) as well as in the operations field generally (Lessard 1986; Hilmola 1999; Helo & Hilmola 2000a; Helo & Hilmola 2000b) researchers have highlighted the possibility to use "real options". By using these, company can modify itself within flexible manner on the changes of business environment. So "real options" do not only consider aspects such as costs and profits, but also the value of time is taken into account. In product development environment this could mean, that some deeply unprofitable products are kept in portfolio, because of their very positive time value. Some of the physical investments in physical machinery and buildings could be sifted to the future too; not because of the possible price discounts, but because of the risk related to technological and business obsolescence.

Our hypothetical example manufacturer also ensured that it will have an option to increase its capacity by 70 percent within very short time, in one period. The costs of this expansion are the same as total amount of basic investment, $22 million. However, no additional increase was required to other expenses, indirect labour and direct labour. This could be achieved with the experience curve (Hirschmann 1964; Abernathy & Wayne 1974; Adler & Clark 1991), because organization is now able to handle increasing material flow with the same amount of "fixed costs".

Capacity expansion is available simultaneously in all growth models, during the third period. All the scenarios were then also lack of manufacturing capacity.[4] In practice this would mean, that management in all analyzed situations should be anxious to take the risks to achieve higher profitability, because capacity expansion decisions should be made between first and second period. During this time there was plenty of spare capacity left from previous investment (platform).

When Figure 5. is compared to the Figure 1., it could be noted that the first three periods are identical. However, after the completed capacity expansion is available for manufacturing, this will improve the performance of all six different growth scenarios. The three highest growing scenarios eventually lose this advantage in the final period, because capacity increase is not sufficient for their needs. Also three lowest growing scenarios will face the similar situation, but they will benefit from the increased capacity during the fourth period most in terms of total productivity performance. The most impressive performance is achieved by the lowest growing scenario, its total productivity performance will decrease only slightly (least volatility). Interestingly the second lowest growth scenario has highest total productivity performance during the fourth period. However, if these findings are compared to the results got from Figure 6., it could be concluded that the highest cumulative profits are achieved again within the highest growing scenario and visa versa. It is also interesting to see, that the third and second lowest growth scenarios will approach each other in terms of cumulative profits during the final period. So the same collision still exists, total productivity model suggests complement growth scenarios as the most achievable as compared to cumulative profits.

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[4] Growth scenario of 25 percent had some spare, but almost achieved 100 percent utilization.

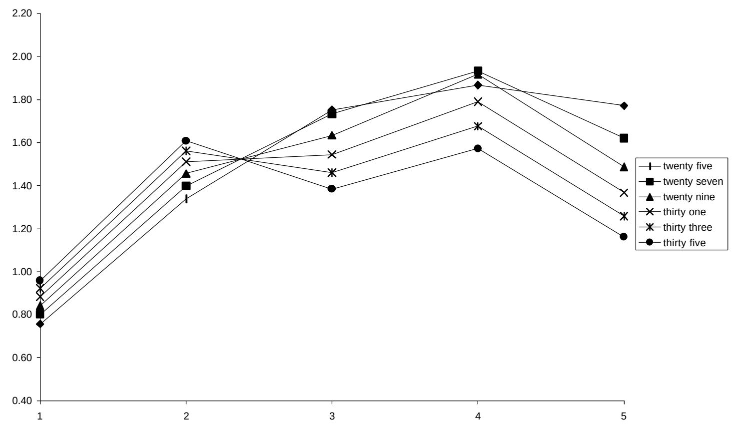

Figure 5. Total productivity development during estimated life-cycle.

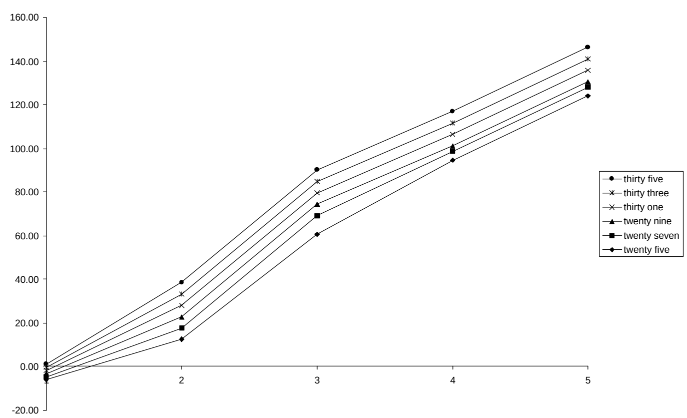

Figure 6. Cumulative profits during estimated life-cycle.

As could be assumed in the first place, the effect of capacity expansion to the inventory turns should be the most significant. However, Figure 7. suggest almost opposite. Even the lowest growing scenario will face tremendous decline in the inventory turns during the final period (lead time performance nearly doubles). In all other scenarios some improvement after investment decisions could be identified, but during the final period all the benefits have been lost. It seems, that growth scenarios which have the most remarkable improvement during the fourth period will have greater decline in the following period.

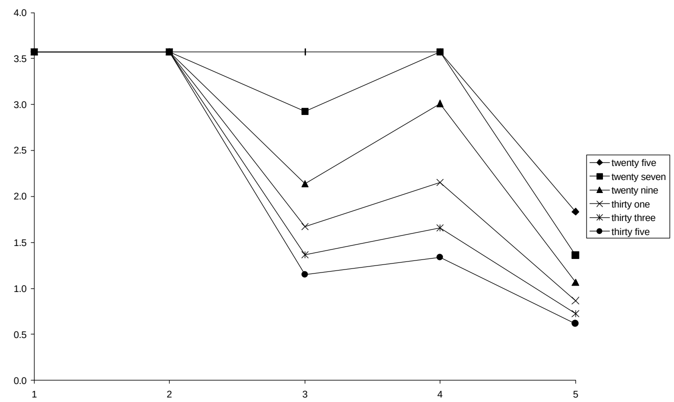

Figure 7. Development of inventory turns during estimated life-cycle.

The most impressive effect investment has on the cash flow. After the third period capacity expansion is available for the use, and it will decrease cash reserves during this period significantly (Assumed that the expansion is delivered in the final parts of the third period.). As could be noted from the Figure 8., cash flow really improved during the fourth period in all different growth scenarios. However, on latter period all the others than lowest growing will have difficulties. If all cash flows during their entire life cycle from different growth scenarios are discounted with interest rate of 10 % p.a., the third lowest growth scenario will achieve the highest DCF performance. The lowest performance is gained from the lowest growing scenario, and second lowest from the highest performing one. The differences are not so wide, because the difference between the poorest and the highest performing is only about six percent. But if the performance is compared to the firstly introduced hypothetical situation, the difference is remarkable. The lowest DCF performance in this hypothetical example has over 60 percent greater cash flow than best performing growth scenario in the previous hypothetical example.

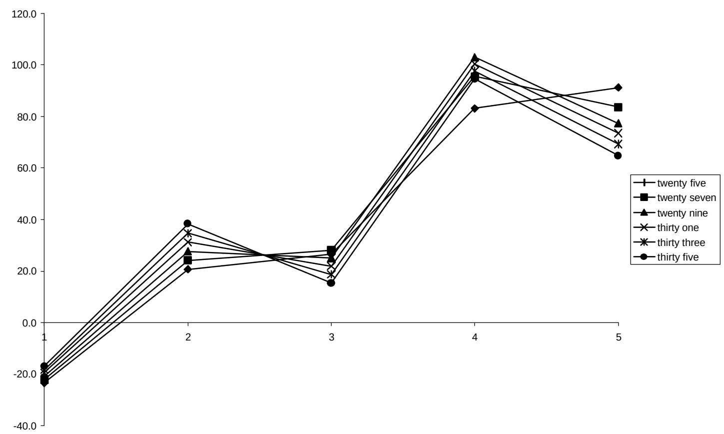

Figure 8. Cash flow development during estimated life-cycle.

5. CONCLUSIONS

So how profitable is it to be fastest growing anyway? Too customer orientated organization might gather all the orders, but what if the orientation has forgot manufacturing? Some might argue, that the measurement of inventory turns will solve problems and give its guidance. As was presented in this paper, it does not have same control effect as total productivity, even if the organization is working in almost ideal environment. However, controlling of the inventory is not without any purpose. The highest growing scenario will have on its liability large amount of inventory during the final period in both hypothetical examples. In fact it owns over 75 percent more inventory than the highest DCF growth scenario in first hypothetical example. In the second example the highest growing scenario had over 40 percent more inventory than the highest DCF growth scenario.

As within every businesses, customers will react on lead time increases somehow and this in turn will create proper environment for product substitutes. If the next generation of products should be introduced during the sixth period, which growth option will have the advantage? Of course the use of product platforms (increasing commonality) and concurrent new product introductions could give their benefits for the higher growing options – as Solomon (1966) argued decades ago that the estimate of economic life-cycle of investment is more important than estimated level of pre-tax profits during its life-cycle. But is the core competence build-up on the products or know-how (see Prahalad 1993)? With the higher than estimated growth organization could end-up on the core competence related to current inventory, old products. In the consequence of this closer relations are needed with current major customers (Alahuhta 1990, *"technology pull"*). This could eventually lead on increased resistance of newer technologies in offered products. This chain might have also disastrous results in the longer term. For instance, Bower & Christensen (1995: 153) describe following: *"In spite of this aggressive technological posture, no single disk-drive manufacturer has been able to dominate the industry for more than a few years. A series of companies have entered the business and risen to prominence, only to be toppled by newcomers who pursued technologies that at first did not meet the needs of mainstream customers. As a result, not one of the independent disk-drive companies that existed in 1976 survives today."* Similarities could also be found from pharmaceutical industry. According to Ravenscraft et al. (2000: 307-308) right after the oligopoly created with a patent has diminished, the genetic drug firms are ready to react, and eventually take the market share.

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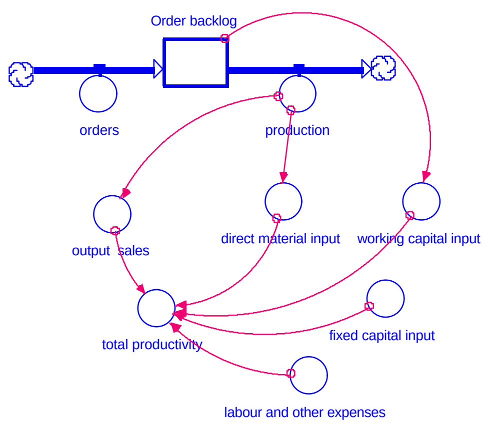
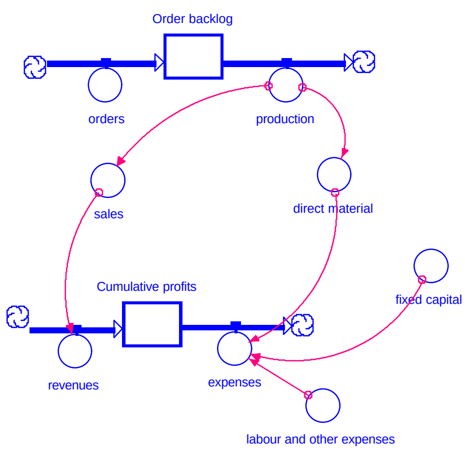
APPENDICES

Appendix A – Stella model of total productivity measurement



Appendix B – Stella model of cumulative profits



Appendix C – Stella model of cash flow and inventory turns