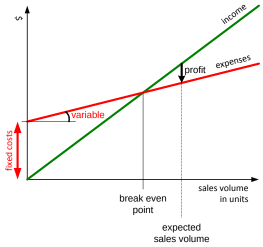
Simplistic Financial Computations for System Architects.

-



Gerrit Muller
USN-SE
Hasbergsvei 36 P.O. Box 235, NO-3603 Kongsberg Norway
gaudisite@gmail.com

Abstract

This document explains how simple financial estimates can be made by system architects. These simplistic estimates are useful for an architect to perform sanity checks on proposals and to obtain understanding of the financial impact of proposals. Note that architects will never have full fledged financial controller know how and skills. These estimates are zero order models, but real business decisions will have to be founded on more substantial financial proposals.

version: 1.3 status: preliminary draft March 27, 2021

1 Introduction

Many system architects shy away from the financial considerations of the product creation. In this document a very much simplified set of models is offered to help the architect in exploring the financial aspects as well. This will help the architect to make a ”sharper” design, by understanding earlier the financial aspects.

The architect should always be aware of the many simplifications in the models presented here. Interaction with real financial experts, such as controllers, will help to understand shortcomings of these models and the finesses of the highly virtualized financial world.

In Section 2 a very basic cost and margin model is described. Section 3 refines the model at the cost side and the income side. In Section 4 the time dimension is added to the model. Section 5 provides a number of criteria for making finacial decisions.

2 Cost and Margin

The simplest financial model looks only at the selling price (what does the customer pay), the cost price (how much does the manufacturing of the product actually cost). The difference of the selling price and the cost price is the margin. Figure 1 shows these simple relations. The figure also adds some annotations, to make the notions more useful:

- the cost price can be further decomposed in material, labor and other costs
- the margin (”profit per product”) must cover all other company expenses, such as research and development costs, before a real profit is generated
- most products are sold as one of the elements of a value chain. In this figure a retailer is added to show that the street price, as paid by the consumer, is different from the price paid by the retailer[1].

The annotation of the other costs, into transportation, insurance, and royalties per product, show that the model can be refined more and more. The model without such a refinement happens to be rather useful already.

The translation of margin into profit can be done by plotting income and expenses in one figure, as shown in Figure 2, as function of the sales volume. The slope of the expenses line is proportional with the costs per product. The slope of the income line is proportional with the sales price. The vertical offset of the expenses line are the fixed organizational costs, such as research, development, and overhead costs. The figure shows immediately that the sales volume must exceed the break even point to make a profit. The profit is the vertical distance between expenses and income for a given sales volume. The figure is very useful to obtain insight in the

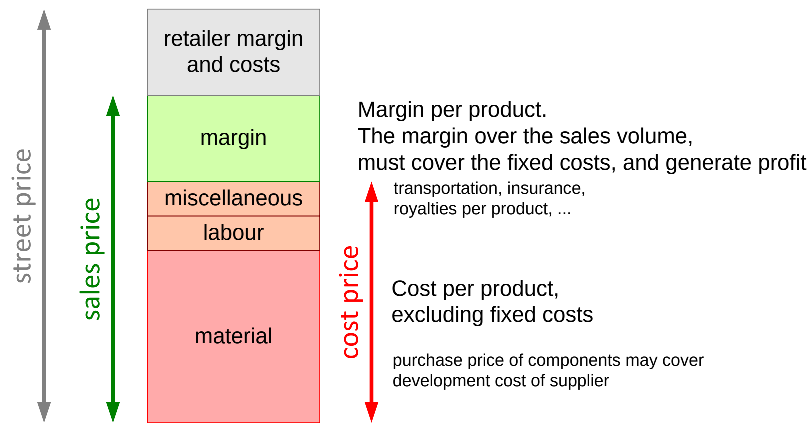


Figure 1: The relation between sales price, cost price and margin per product

robustness of the profit: variations in the sales volume are horizontal shifts in the figure. If the sales volume is far away from the break even point than the profit is not so sensitive for the the volume.

3 Refining investments and income

The investments as mentioned before may be much more than the research and development costs only, depending strongly on the business domain. Figure 3 shows a decomposition of the investments. The R&D investments are often calculated in a simple way, by using a standard rate for development personnel that includes overhead costs such as housing, infrastructure, management and so on. The investment in R&D is then easily calculated as the product of the amount of effort in hours times the rate (=standardized cost per hour). The danger of this type of simplification is that overhead costs become invisible and are not managed explicitly anymore.

Not all development costs need to be financed as investments. For outsourced developments an explicit decision has to be made about the financing model:

- the supplier takes a risk by making the investments, but also benefits from larger sales volumes
- the company pays the investment, the so called Non Recurring Engineering (NRE) costs. In this case the supplier takes less risks, but will also benefit less from larger sales volumes.

If the supplier does the investment than the development costs of the component

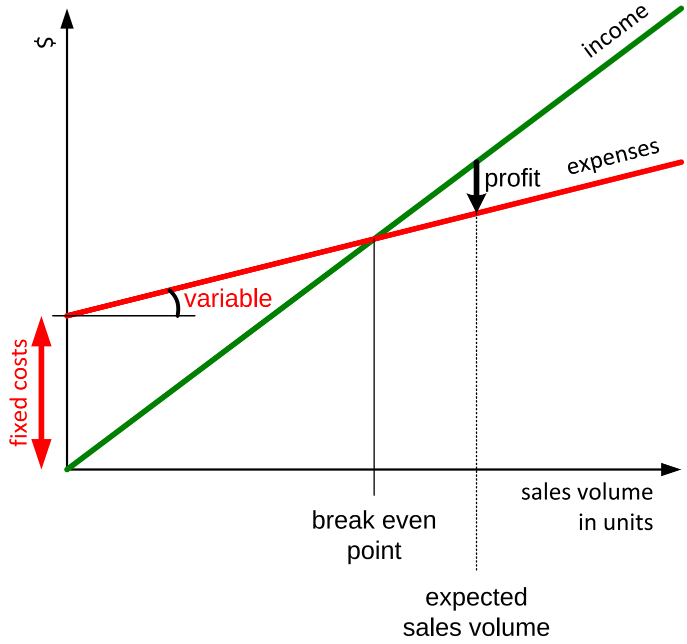


Figure 2: Profit as function of sales volume

are part of the purchasing price and become part of the material price. For the NRE case the component development costs are a straightforward investment.

Other investments to be made are needed to prepare the company to scale all customer oriented processes to the expected sales volume, ranging from manufacturing and customer support to sales staff. In some business segments the marketing costs of introducing new products is very significant. For example, the pharmaceutical industry spends 4 times as much money on marketing than on R&D. The financial costs of making investments, such as interest on the capital being used, must also be taken into account.

We have started by simplifying the income side to the sales price of the products. The model can be refined by taking other sources of income into account, as shown in Figure 4. The options and accessories are sold as separate entities, generating a significant revenue for many products. For many products the base products are sold with a loss. This loss is later compensated by the profit on options and accessories.

Many companies strive for a business model where a recurring stream of revenues is created, for instance by providing services (access to updates or content), or by selling consumables (ink for prink jet printers, lamps for beamers, et cetera).

One step further is to tap the income of other players of the value chain.

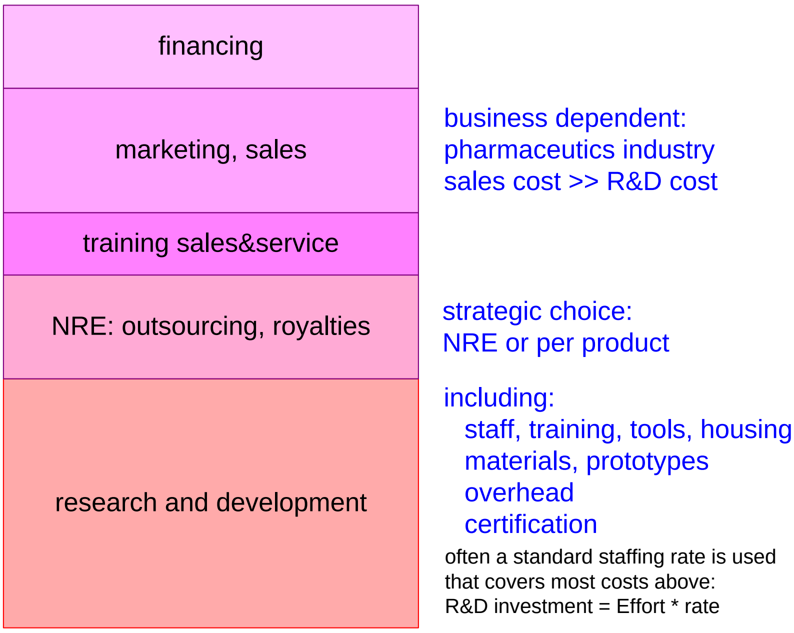


Figure 3: Investments, more than R&D

Example is the license income for MPEG4 usage by service and content providers. The chip or box supplier may generate additional income by partnering with the downstream value chain players.

4 Adding the time dimension

All financial parameters are a function of time: income, expenses, cash-flow, profit, et cetera. The financial future can be estimated over time, for example in table form as shown in Figure 5. This table shows the investments, sales volume, variable costs, income, and profit (loss) per quarter. At the bottom the accumulated profit is shown.

The cost price and sales price per unit are assumed to be constant in this example, respectively 20k$ and 50k$. The formulas for variable costs, income and profit are very simple:

$$variable\ costs = sales\ volume * cost\ price$$

$$income = sales\ volume * sales\ price$$

$$profit = income - (investments + variable\ costs)$$

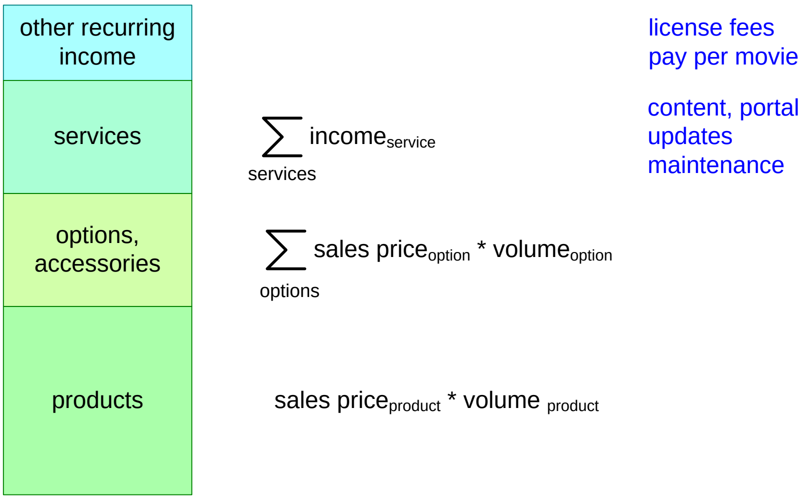


Figure 4: Income, more than product sales only

Figure 6 shows the cumulative profit from Figure 5 as a graph. This graph is often called a "hockey" stick: it starts with going down, making a loss, but when the sales increase it goes up, and the company starts to make a profit. Relevant questions for such a graph are:

- when is profit expected?
- how much loss can be permitted in the beginning?
- what will the sustainable profit be in later phases?

These questions can also be refined by performing a simple sensitivity analysis.

	Y1 Q1	Y1 Q2	Y1 Q3	Y1 Q4	Y2 Q1	Y2 Q2	Y2 Q3
investments	100k$	400k$	500k$	100k$	100k$	60k$	20k$
sales volume (units)	-	-	2	10	20	30	30
material & labour costs	-	-	40k$	200k$	400k$	600k$	600k$
income	-	-	100k$	500k$	1000k$	1500k$	1500k$
quarter profit (loss)	(100k$)	(400k$)	(440k$)	200k$	500k$	840k$	880k$
cumulative profit	(100k$)	(500k$)	(940k$)	(740k$)	(240k$)	600k$	1480k$

cost price / unit = 20k$
sales price / unit = 50k$

variable cost = sales volume * cost price / unit
income = sales volume * sales price / unit
quarter profit = income - (investments + variable costs)

Figure 5: The Time Dimension

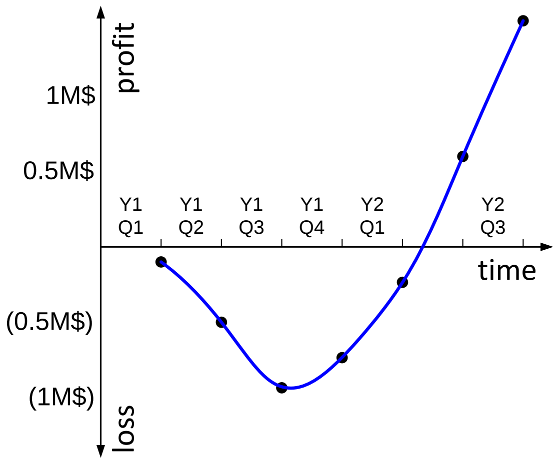


Figure 6: The “Hockey” Stick

Figure 7 shows an example of such an analysis. Two variations of the original plan are shown:

- a development delay of 3 months
- an intermediate more expensive product in the beginning, followed by a more cost optimized product later

The delay of 3 months in development causes a much later profitability. The investment level continues for a longer time, while the income is delayed. Unfortunately development delays occur quite often, so this delayed profitability is rather common. Reality is sometimes worse, due to loss of market share and sales price erosion. This example brings two messages:

- a go decision is based on the combination of the profit expectation and the risk assessment
- development delays are financially very bad

The scenario starting with a more expensive product is based on an initial product cost price of 30k$. The 20k$ cost price level is reached after 1 year. The benefit of an early product availability is that market share is build up. In this example the final market share in the first example is assumed to be 30 units, while in the latter scenario 35 units is used. The benefits of this scenario are mostly risk related. The loss in the beginning is somewhat less and the time to profit is somewhat better, but the most important gain is be in the market early and to reduce the risk in that way. An important side effect of being early in the market is that early market feedback is obtained that will be used in the follow on products.

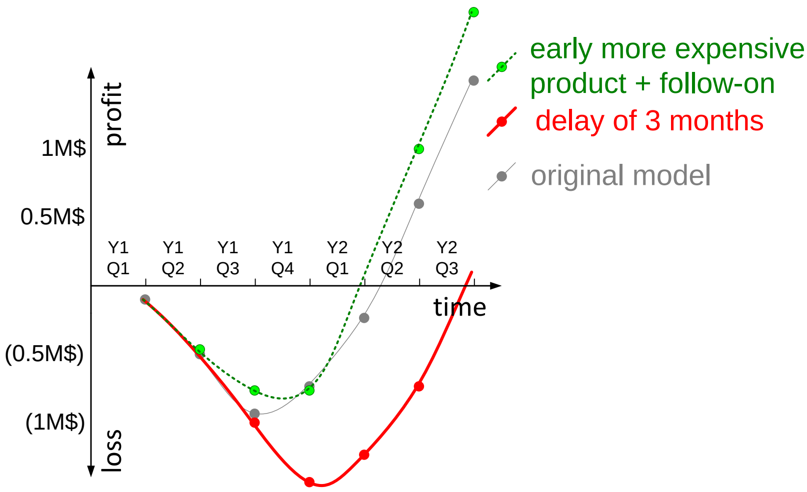


Figure 7: What if ...?

In reality, a company does not develop a single product or system. After developing an initial product, it will develop successors and may be expand into a product family. Figure reffig:SFCmultipleDevelopments shows how the cumulative profits are stacked, creating an integral hockey stick for the succession of products. In this graph the sales of the first product is reduced, while the sales of the second product is starting. This gradual ramp-up and down is repated for the next products. The sales volume for the later products is increasing gradually.

5 Financial yardsticks

How to assess the outcome of the presented simple financial models? What are *good* scenarios from financial point of view? The expectation to be profitable is not sufficient to start a new product development. One of the problems in answering these questions is that the financial criteria appear to be rather dynamic themselves. A management fashion influences the emphasis in these criteria. Figure 9 shows a number of metrics that have been fashionable in the last decade.

The list is not complete, but it shows the many financial considerations that play a role in decision making.

Return On Investments is a metric from the point of view of the shareholder or the investor. The decision these stakeholders make is: what investment is the most attractive.

Return On Net Assets (RONA) is basically the same as ROI, but it looks at all the capital involved, not only the investments. It is a more integral metric

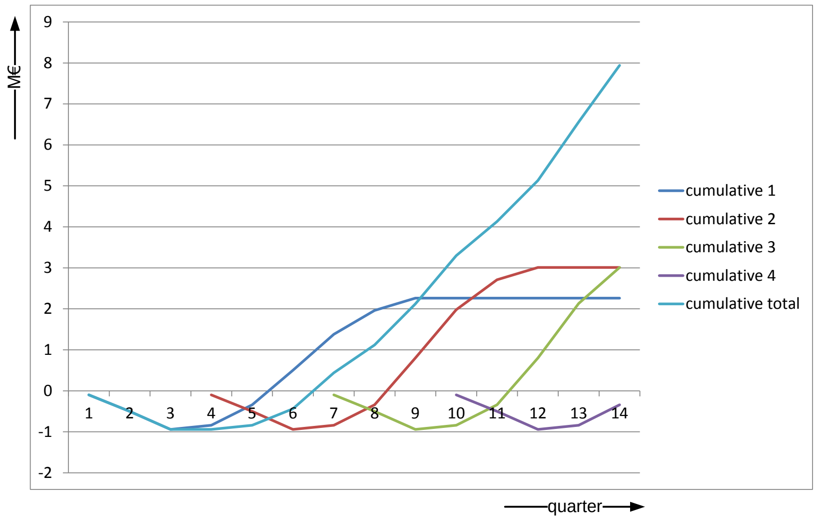


Figure 8: Stacking Multiple Developments

than ROI.

turnover / fte is a metric that measures the efficiency of the human capital. Optimization of this metric results in a maximum added value per employee. It helps companies to focus on the core activities, by outsourcing the non-core activities.

market ranking (share, growth) has been used heavily by the former CEO of General Electric, Jack Welch. Only business units in rank 1, 2 or 3 were allowed. Too small business units were expanded aggressively if sufficient potential was available. Otherwise the business units were closed or sold. The growth figure is related to the shareholder value: only growing companies create more shareholder value.

R&D investment / sales is a metric at company macro level. For high-tech companies 10% is commonly used. Low investments carry the risk of insufficient product innovation. Higher investments may not be affordable.

cashflow is a metric of the actual liquid assets that are available. The profit of a company is defined by the growth of all assets of a company. In fast growing companies a lot of working capital can be unavailable in stocks or other non salable assets. Fast growing, profit making, companies can go bankrupt by a negative cash-flow. The crisis of Philips in 1992 was caused by this effect: years of profit combined with a negative cash-flow.

Return On Investments (ROI)

Net Present Value

Return On Net Assets (RONA) leasing reduces assets, improves RONA

turnover / fte outsourcing reduces headcount, improves this ratio

market ranking (share, growth) "only numbers 1, 2 and 3 will be profitable"

R&D investment / sales in high tech segments 10% or more

cash-flow fast growing companies combine profits with negative cash-flow, risk of bankruptcy

Figure 9: Fashionable financial yardsticks

6 Acknowledgements

William van der Sterren provided feedback and references. Hans Barella, former CEO of Philips medical Systems, always stressed the importance of Figure 2, and especially the importance of a robust profit. Ad van den Langenberg pointed out a number of spelling errors.

References

[1] Mark Abraham. Define and price for your market starting at end market values! `http://www.sticky-marketing.net/articles/pricing-for-channels.htm`, 2001.

[2] Gerrit Muller. The system architecture homepage. `http://www.gaudisite.nl/index.html`, 1999.

History

Version: 1.3, date: July 27, 2014 changed by: Gerrit Muller

- added NPV to list of yard sticks

- added multiple developments

Version: 1.2, date: November 29, 2010 changed by: Gerrit Muller

- added units to financial figures

Version: 1.1, date: March 2, 2005 changed by: Gerrit Muller

- spelling improvement

Version: 1.0, date: May 3, 2004 changed by: Gerrit Muller

- added Figure Fashionable financial yardsticks
- added text
- changed status to preliminary draft
- logo defined

Version: 0.1, date: April 1, 2004 changed by: Gerrit Muller

- added retailer to cost and margin figure
- added section Acknowledgements
- added reference to sticky-marketing.net

Version: 0, date: March 29, 2004 changed by: Gerrit Muller

- Created, no changelog yet