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Traditional Price Determinants in Software Projects, with Consideration to Non-Corrective Maintenance

José-María Torralba-Martínez, Marta Fernández-Diego, and José Cuenca Iniesta

To determine the price of a project, traditional pricing policy determinants (demand, competition and cost) must all be taken into account, as should other business and marketing policy related factors, all of which make price determination a complicated activity. When software deals are expected to lead to non-corrective maintenance (whether adaptive, preventive, or perfective) in the future, the additional business generated by such maintenance during the useful life of the software may also be taken into account when establishing the price of software.

Keywords: Non-Corrective Maintenance, Pricing Policy, Software Price.

1 Introduction

Estimating the supply price of a software project requires the use of various scientific and academic disciplines:

a) Software Engineering, since details of how to measure the size and estimate the amount of resources needed are included in texts on this subject [1][2][3].

b) Cost and management accounting: to determine the supplier's cost estimate

c) Marketing, as this subject includes pricing policy [4][5][6][7].

It is, therefore, a multi-disciplinary activity .

In this article, we outline some considerations on the three traditional determinants that affect supply price: demand, competition and costs, as applied to software projects. The fact that software projects may require non-corrective maintenance (either of an adaptive, preventative or perfective nature) could also influence the supply price, given the business expectations created when a project is developed.

When speaking about the difficulty of estimating software project sales prices, an additional point to be borne in mind (in addition to the interdisciplinary nature of pricing already mentioned) is that there are usually large differences between historic cost (i.e. the actual development cost of the project, as determined on its completion) and the final price that is established after sales negotiations are concluded.

These differences depend on at what stage in the life cycle of the project the deal is actually closed; the earlier the price estimation is made, the greater the difference tends to be. Figure 1 shows the estimated sale price at a given moment in the project's life cycle, expressed as a percentage of historical cost. This graph is based on projects carried out by Boehm [8][9][10] in the 90s, which were both innovative and large in scale and complexity.

Given such variability, this limitation (the difficulty of estimating a supply price) must be taken into account, especially when price estimation takes place early on. The price determination process is described briefly below.

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2 Supply Price Determination Process

When a customer decides to order a software project from a supplier, and once the supplier calculates the cost that he will have to incur, there is still a long way to go before the *supply price* is determined, as shown in Figure 2.

But before describing all the details and considerations of this process, it should also be noted that price is not the only factor necessary to win over a potential customer.

2.1 Price as one of the Components of the Customer Offering

Before beginning the pricing study, it should be borne in mind that this is only one of the components of the cus-

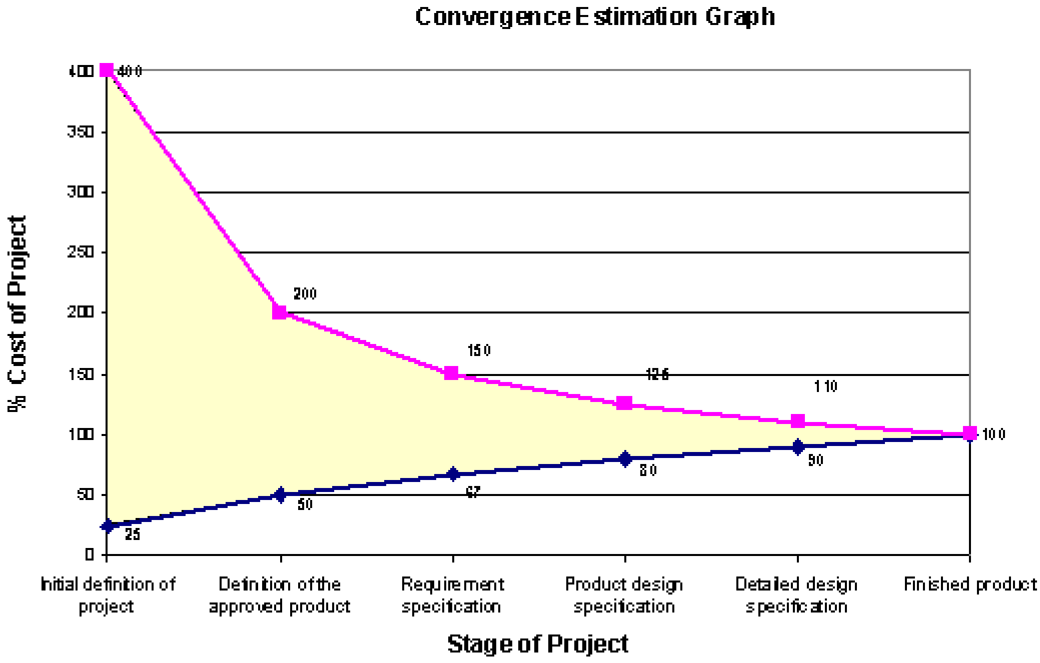

Figure 1: Evolution of Price Variability of a Software Project according to the Moment of Price Determination in a Project's Life Cycle (Source: Reproduced from Boehm et al. [8]).

tomer offering. For any given project, the supplier communicates to the potential customer his willingness to carry out the project, given certain specified conditions:

a) Scope and function of the product.
b) Timing.
c) Supply price.
d) Quality, innovation etc.
e) Training.
f) After-sales service.
g) Assurance in terms of finishing the project.
h) Financial conditions (payment terms etc).
i) Image, brand etc.

All of this forms part of the customer offering. In this article, only one of these components is discussed (that of price). However, it should always be borne in mind that the customer offering is not just about price but includes all the aspects mentioned above and more besides.

3 Traditional Price Determinants

Marketing texts usually refer to the following traditional

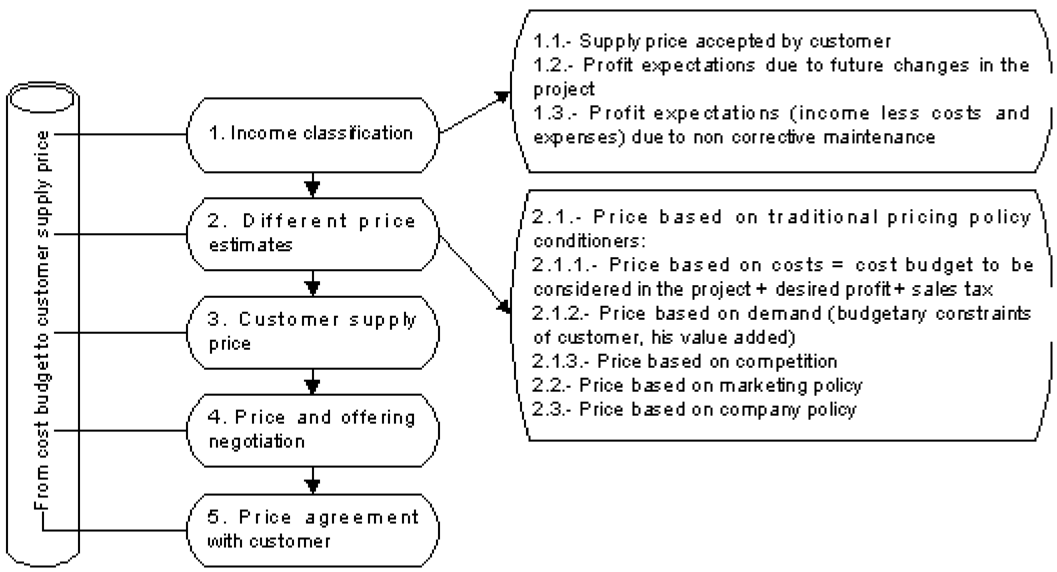

Figure 2: Stages in Supply Price Determination Process for Tailor-made Software, starting from Supplier's Cost Budget. (Source: Torralba [19][20]).

price determinants for any product or service [11]:

- Costs.
- Market (competition, demand, market /industry).
- Characteristics of the company's offering (product, price, distribution, and other marketing variables).
- Circumstances particular to the company.
- Technology.
- Environment.
- Information.

with the three traditional determinants being demand, competition, and costs. We go on to describe how these are applied to the pricing of software projects.

3.1 Demand as a Traditional Price Determinant

Customer Reserve Price refers to the "*maximum monetary amount that the customer is willing to pay for a given project*."[1] [12].

In project terminology, this corresponds to the budget limit established by the customer for the project in question. There is a price limit (the customer's budget limit) above which the potential customer who negotiates with the supplier will not order the tailor-made software project. In general, the customer will attempt to obtain a price as far below this limit as possible, all other conditions remaining constant. Therefore:

a) When the supply price is equal to or less than the budget limit, there may be a demand for the project

b) Above the budget limit (customer reserve price) there will be no demand for the project.

[1] "According to the principle of cost/profit, a customer will acquire the project if the profit hoped for is higher than or equal to the price." ([12], p. 66), (adapted for projects).

Therefore, demand can be represented graphically by two stages of a vertical line (see Figure 3, demand represented by the thick line).

a) a vertical straight line, (in this case there is just one project; i.e. just one unit) which reaches the point equal to the budget limit.

b) another vertical line, on the "open" side of the price axis, which goes beyond the level of the budget limit. This line indicates that demand is nil (the project is not ordered; zero units of the project are ordered from this supplier.).

This budgetary limitation can be either explicit or implicit. It is explicit if the party interested in the given project (a company, organization etc.) has formally established a budget limit for the project. It is implicit when the negotiating party on behalf of the customer has decision-making capacity to determine this price limit. However, in both cases, there is a budget limit above which the project will not be ordered from a given supplier. Therefore, this budget limit (willingness to pay) is what determines the customer supply price and is the main equivalent to what is generally referred to in marketing texts as "demand".

It can be deduced from the above that, when determining a tailor-made software project's supply price, the "demand" determinant can be expressed in the equation on Table 1.

<u>DEMAND DETERMINANT:</u>
For certain given supply characteristics, the following must hold:
Supply price by supplier ABC to customer XYZ < = Budget Limit (willingness to pay) of customer XYZ

Table 1: Equation expressing the Demand Determinant.

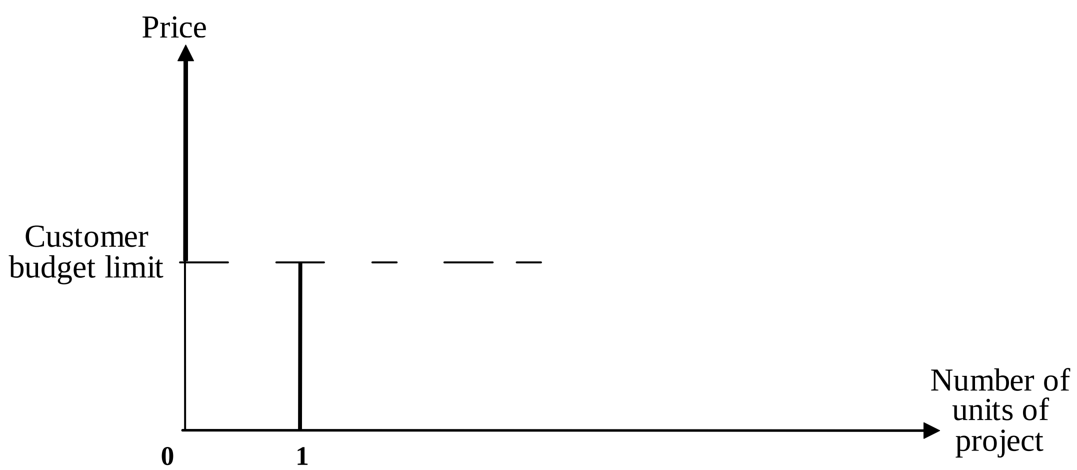

Figure 3: Customer Budget Limit as the Upper Limit of the Supply Price, Plotted against the "Demand" Determinant.

This budget limit is what the customer initially considers when valuing whether the project will be viable from varying perspectives:

- budget-wise, i.e. the total expense must not exceed this limit.
- financially.
- economically or socially etc.

On the other hand, if the rest of conditions are the same, the lower the price, the happier the customer will be.

To conclude, to establish the supply price this demand determinant (budget limit) must be taken into account. We go on to describe other traditional market price determinants.

3.2 Competition as a Traditional Price Determinant

If there is competition in the market, the supplier will decide: 1) not to submit an offer to a specific potential customer if they decide they cannot compete, or 2) to submit an offer, trying to equal or better the bid submitted by competitors.

In the first instance, it is obvious that the circumstances of the competition influences the supplier, as he decides not to submit an offer. The decision not to submit an offer is based on knowledge of the competition as well as the fact that to put in an offer requires some form of work (prior study, pre-project, project itself). This work inevitably has a cost and if the project is not won these explicit costs are not recouped.

If it is decided to submit an offer, success will not be guaranteed unless the competitors' offers are bettered. As has been indicated, price is only one of the elements that the customer values or takes into consideration when deciding what offer to accept.

In short, competitors' offers influence the price that a supplier may offer a customer, as their bids will not be accepted at a price that, taking into account all other considerations, does not improve on the competition's offer.

It can be deduced from the above that, when determining a tailor-made software project's supply price, the "competition" determinant can be expressed in the equation in Table 2.

<u>COMPETITOR DETERMINANT:</u>
For certain given supply characteristics, the following must hold:
Supply price by supplier ABC to customer XYZ < = ABC's Competitors' supply price to customer XYZ

Table 2: Equation expressing the Competitor Determinant.

A particular case is represented by innovative projects in their relevant markets. In the comparison that customers carry out when comparing offers between the supplier and their competition, the amount of innovation in the project should be taken into account. If one supplier's project is innovative in his given relevant market, one could say that there is no competition, in which case the customer would lack a price reference comparison regarding competitors. In this situation, the supplier may adopt one of two different strategies: a) Maximum price (what a customer is willing to pay, i.e. in this case, it is the demand determinant that comes into play, and the maximum price would have to be less than or equal to the customer's budget limit) or b) Non-maximum price, dependent on the criteria established by marketing pricing policy [13].

3.3 Cost as a Traditional Price Determinant

Although this is the last determinant to be described, it is perhaps the best known, as it frequently appears in project texts as the way to determine price. The relevant equation is shown in Table 3.

<u>COST DETERMINANT:</u>
Supply price based on cost =relevant cost + desired profit + sales tax

Table 3: Equation expressing the Cost Determinant.

From this relationship, it can be observed that cost determines price. Given that profits obtained by companies are usually a small percentage of revenues, i.e. of sales volume, it may be said that cost is a key determining element (and is a high percentage of the price calculated in this way, excluding taxes).

In the calculation of the cost to determine the price, the particular feature that the software has, that it *is reusable*, must be considered, in addition to other common aspects, which is why the term *relevant cost* is used.

The three traditional price determinants are shown in Figure 4, which also shows the possible price range, which is limited at the top end by the maximum price acceptable to the customer (or, in this case, consumer) *(the customer's budget limit*), and at the bottom end by the minimum price (*the supplier's relevant cost*), with the situation regarding competitors influencing the last instance. Other aspects also appear in the aforementioned Figure.

3.4 Marketing and Company Policy as Price Determinants

Although not within the scope of this paper, it should be noted that price determination according to the three traditional determinants (*demand, competition and cost*) is not the end of the long road that leads to the setting of a supply price (see Figure 2), as other variables enter the fray, such as pricing and marketing policy (product, positioning, etc.) and yet more variables from the general company policy, which could affect the supply price to a greater or lesser extent.

Neither does the negotiation that takes place between supplier and customer to establish the definitive supply price fall within the scope of this paper, which is itself a key determining factor of the agreed price (see Figure 2.)

Finally, the monitoring and control of measurement, estimation, and costs is a fundamental aspect in terms of managing the project in question, as well as for improving these stages of the budget process in future projects.

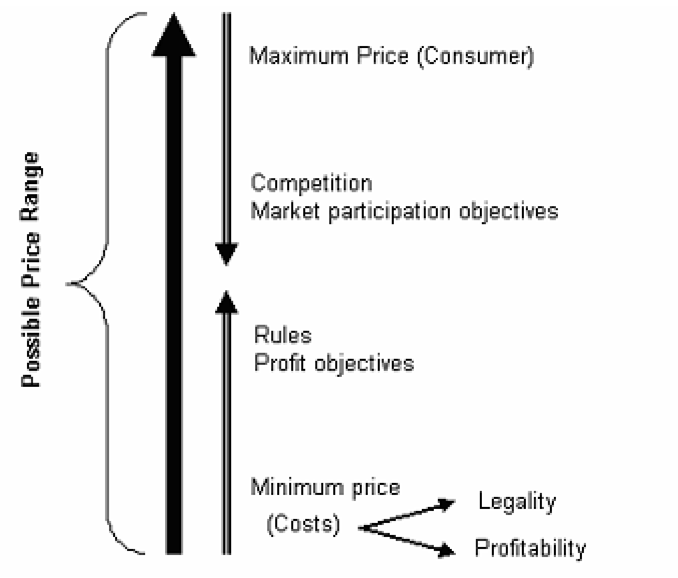

Figure 4: Possible Price Range, Limited by Demand and Cost Determinants.
(Source: Reproduced from Díez de Castro and Rosa [11]).

To conclude, Figure 2 shows breakdown of project revenue which is discussed in the following section.

4 Price and Project Revenue

Revenue derived from a project can be classified as follows (see Figure 2):

- Revenue from carrying out the project (supply price as accepted by the customer).
- Expected profit due to changes carried out during the project.
- Expected profit in case of non-corrective maintenance being carried out (revenue less costs) because the software is susceptible to non-corrective maintenance.

Traditional determinants have already been discussed with regard to the revenue stream that corresponds to the supply price. However, it should also be mentioned that some additional profits can be expected from any changes during the "execution" phase of the project (modifications and redesign), which is very frequent in software projects.

The next revenue stream is *expected profits in the case of non-corrective maintenance*. This refers only to any expected business that might arise in the event of any non-corrective maintenance being necessary during the execution of the project.

A characteristic of software is that it allows for different types of maintenance. As far as this article is concerned, the following classification for made-to-measure software maintenance is interesting [14][15][16], which is based on: a) corrective, b) non-corrective. The first, as is well known, aims to correct any errors that may arise due to their not having been detected in the software testing phase, which takes place before the product is delivered to the customer. The second type, non-corrective maintenance, is normally broken down as follows: a) adaptive, b) perfective or improvement and c) preventive (what other authors occasionally refer to as software reengineering.)

With these three types of non-corrective maintenance in mind, it may be supposed that programs will always be subject to continuous change (Lehman's 1st. Law states constant change in programs [15]).

Software's characteristic of being susceptible to non-corrective maintenance gives rise to a particular situation with regard to revenue. If the potential customer contracts the project from a supplier, revenue streams are: a) the contract price, with the terms and conditions of payment as agreed and b) profits (revenue less expenses) that the project may generate when it is operational, in terms of non-corrective maintenance, although it remains only an expectation when negotiating the supply price.

The supplier should bear this aspect of software in mind, and therefore should consider that if the contract is awarded, a new potential revenue stream is opened up due to future business (and future profits) relating to non-corrective maintenance, always assuming, of course, that the supplier is contracted to carry this maintenance out.

5 Conclusion

In the budgetary process that a software project supplier carries out, once the cost budget is available, (see Figure 2), a study into the supply price needs to be carried out from the perspective of the three traditional determinants: Demand, Competition and Costs, as well as other factors, such as marketing and company policy. Therefore, the suppliers' cost budget is an important step, but not the only one, in the establishment of a supply price.

Software possesses the characteristic of being susceptible to non-corrective maintenance, which creates the possibility of future business, which must be taken into account when setting the price. Other complementary aspects can be seen in the bibliography [17][18][19][20][21][22][23].

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