Modelling the marketing of high-tech start-ups

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Abstract This paper attempts to model the marketing and sales process of high-tech start-up companies. It correlates the notions of the marketing mix (the 4Ps) with the probabilities of success of various phases in the sales process. By applying the formalism of reliability block diagrams used in engineering, the total probability of the sales process can be expressed as a function of the probabilities of all the subprocesses. A particular insight resulting from this work is that the total probability of the customer buying decision corresponds to the relative market share of the company. Discussing the allocation of investment in the specific marketing elements of this model will improve understanding of how management can achieve a rapid increase in sales and so accelerate the development of a high-tech start-up company.

INTRODUCTION

Most high-tech start-up companies are built around a more or less genius technical idea of their founders. If the idea is really good, then the high-tech start-up quickly makes a demonstration version to attract the interest of first customers. These first customers are visionaries who match an emerging technology to a strategic opportunity. These early adopters of high-tech products are also called lead customers. The transition from an early market dominated by early customers who take the risk, to the general market with customers who are predominantly pragmatists and just want the benefits of new technology, creates a gap in the

development of a high-tech market. Crossing this gap — or chasm — is a do-or-die proposition for high-tech companies.¹

Selling a start-up's products to general markets relies on the rules of marketing. For a long time, it was thought that marketing was predominantly based on the concept of the marketing mix² of the 4Ps (product, price, promotion, placing).³ More recently, it was found that the 4Ps are inadequate for services and not-for-profit organisations. This led Booms and Bitner⁴ to extend the 4Ps model to include people, process, and physical evidence.

A review of contemporary marketing thoughts can be found in Baccus (2002).⁵

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In the current marketing literature, the concept of the marketing mix of 4Ps (and now 7Ps) tends to lose its importance, although it is still one of the principal marketing theories.⁶ The concept of 4Ps has been criticised as being a production-oriented definition of marketing, and not a customer-oriented one.⁷ However, because most high-tech start-ups are preoccupied with the realisation of their genius technical idea, they *are* production-oriented, and the problem of ‘crossing the chasm’⁸ arises precisely because of this fact. In this paper, therefore, the concept of the marketing mix of 4Ps is applied as the adequate theoretical basis.

This paper develops a novel concept of modelling the marketing process of those high-tech start-up companies about to enter a general market (and cross the chasm). The main aim is to model the process of attracting the interest of potential customers and leading them toward a first purchasing decision. Such a model will help in understanding how to allocate the investment in marketing’s 4Ps to optimise the commercialisation process of high-tech start-up products.

Considerable research effort has been devoted in developing marketing models — see, for example, Smith and Swinyard (2003)⁹ and the references therein. The model proposed in the present paper differs from the marketing models developed up to now by the following main features:

- the present model applies particularly to the marketing of high-tech start-up companies that are trying ‘to cross the chasm’;¹⁰
- the present model directly relies by analogy on a conceptual, graphical and mathematical formalism, which is already well established in an important engineering discipline, namely reliability engineering.¹¹

THE CONCEPT OF THE MODEL

Based on the above arguments, in the present model it is assumed that the most important Ps influencing a first buying decision of a new customer of a high-tech start-up are the classical 4Ps, namely product, price, place, promotion.

First, the customer buying-decision process is modelled by a block diagram, similar to that used in many engineering fields.¹² Each block will describe a phase or a factor influencing the buying decision, for example, promotion, product characteristics, price, place. To each of these blocks a probability of success of the corresponding sales phase will be ascribed. Thus, the sales process can be treated quantitatively by applying the formalism of probability block diagrams.

It is found that the probability ascribed to the most of the 4P-blocks is proportional to the accumulated amount of products already successfully sold. For example, the product quality is proportional to the accumulated know-how, the value of the brand is proportional to the number of sold units, the word-of-mouth advertising is also proportional to the accumulated number of customers, and so on.

THE CUSTOMER BUYING PROCESS

The buying process starts when a potential customer recognises a problem or need (problem recognition) — see Figure 1. At this moment the customer becomes receptive to information, which is called the ‘heightened attention stage’, and may enter into an active information search phase (information search).¹³ The customer looks for reading material, conferences, exhibitions, personal sources such as word of mouth, etc, and becomes a likely customer. Through gathering information they learn about

Figure 1 The buying-decision process: only a set of the total potential customers become aware of the start-up's solution; only some of them start to evaluate the product; and only a subset of them is convinced and decides to buy

competing brands and their features. Out of the total set of available solutions in the market the potential customer will come to know only a subset of these solutions, which is called the awareness set.¹⁴ The likely customers then evaluate the attributes of the alternatives (evaluation):¹⁵ the solution has to satisfy the need, for example, product performance, geometry, etc, and the solution has to give benefits, for example, low-cost solution, support, distribution, readiness to deliver, etc. During the phase of customer's evaluation process, the seller identifies the best matching customer, who becomes a likely customer. The sales engineer invests time in explaining technical details to the likely customers. Then the customer asks for the price and details of the purchase conditions. If the customer is convinced, they decide to buy (purchase decision).

PROBABILITIES OF THE BUYING PHASES

Using Figure 1 as a basis, the customer buying-decision process can be

presented in more detail, as shown in Figure 2. First, those persons looking for a solution need to be made aware that there is a provider in the market with such a solution. To this end, the attention of these potential customers has to be attracted (attention). Secondly, the potential customer has to analyse the new product to evaluate whether it matches requirements (match). If so, they become a likely customer. Thirdly, the likely customer learns about the costs of purchasing that solution, and those costs have to suit them (costs). Fourthly, it has to be convenient for the customer to access this solution (access), for example, readiness to deliver, language of communication, support, etc.

A successful fulfilment of each phase in the process is necessary for the customer's buying decision. To calculate the buying decision's chance of success for each of the sales phases of Figure 2, the following probabilities of success will be ascribed: P_1 , P_2 , P_3 and P_4 .

P_1 is the probability that the persons looking for a solution will learn about the new offering in the marketplace:

Figure 2 The customer buying-decision process modelled as a series of partial decisions: after each of the phases of evaluating a potential supplier, the customer decides either to continue the evaluation or to look for another supplier

$$P_1 = \frac{N_{\text{pot}}}{N_{\text{tot}}}.$$

N_{pot} is the total number of persons that successfully learned about the offering and N_{tot} is the total number of persons who could, in principle, use the start-up's solution for their problem.

P_2 is the probability that persons who evaluate the start-up's product find that it matches their requirements, expressed as:

$$P_2 = \frac{N_{\text{match}}}{N_{\text{pot}}}.$$

N_{match} is the number of persons whose requirements match better with the

(1) start-up's product than with competitive products.

P_3 is the probability that the costs suit the persons, expressed as:

$$P_3 = \frac{N_{\text{costs}}}{N_{\text{match}}}.$$

N_{costs} is the number of persons that accept the costs.

P_4 is the probability that it is convenient for the persons to purchase the product, expressed as:

$$P_4 = \frac{N_{\text{buy}}}{N_{\text{costs}}}.$$

where N_{buy} is the number of persons that found the solution — the start-up's product — and decide to buy.

Total probability

To the first approximation it is possible to treat the above partial decisions of the customer buying process as independent events.^{16,17} Therefore, the corresponding probabilities P_1 , P_2 , P_3 and P_4 are also independent. According to the theory of probability,^{18,19} the intersection of the positive outcome of all four partial decisions is given by:

$$P = P_1 P_2 P_3 P_4. \quad (5)$$

Substituting the equations (1)–(4) here obtains:

$$P_2 = \frac{N_{\text{buy}}}{N_{\text{tot}}}. \quad (6)$$

Obviously, the result corresponds to the definition of the probability of the positive outcome of the buying process.

In the case of an established business, the 4Ps (or for that matter, the 7Ps) cannot be considered independent of each other. In the present case, however, the problem is the acquisition of new customers and their first (not repeated) buying decision. An approximation of independent influence of each of the Ps and a 'series connection' of the corresponding phases towards a buying decision should, therefore, be acceptable.

Generally speaking, the time a customer takes to go through the buying-decision process is an important issue, which has a major impact on the company's sales. In the case of a start-up company, which is in the phase of 'crossing the chasm',²⁰ it is known that this process takes about one year. In the present model, therefore, the time is not specifically taken as a variable.

VENDOR'S SELLING PROCESS

In this section the relationships between the customer's buying process and the start-up's marketing and sales activities will be established. To this end the customer's buying-decision process of Figure 2 is transformed into the vendor's selling process shown in Figure 3. The transformation is based on Lauterborn's idea that the seller's 4Ps (promotion, product, price, place) correspond to the buyer's 4Cs (communication, customer solution, customer costs, convenience).²¹

From the point of view of a start-up company, the customer buying-decision process corresponds to the start-up's marketing mix that includes the 4P elements: promotion, product, price, place.²² In Figure 3 a marketing mix element is ascribed to each phase of the customer buying-decision process.

The promotion block corresponds to the phase of successfully attracting the customer's attention. The product block incorporates the solution for the customer's needs: product performance, geometry, etc. The price block dominantly determines the customer's costs: the customer pays for the value they receive. The place block corresponds to the customer's convenience of accessing the solution: distribution, readiness to deliver, support, etc.

The structure of the customer's buying-decision process in Figure 3 is analogous to a reliability block diagram used for reliability engineering.²³ A probability is ascribed to each of the blocks. The probability can be calculated at different hierarchical levels of the reliability block diagram. The blocks of the vendor's selling process will be analysed in detail and the technique of the reliability block diagram will be used to calculate the probability of the customer's buying decision.

Figure 3 Customer's buying-decision process from the seller's point of view: all four marketing mix elements influence the customer's buying decision

Promotion: attracting the customer's attention

By definition, promotion includes all the activities a company undertakes to communicate and promote its products to the target markets.²⁴ A potential customer becomes aware of the start-up's offerings through published papers in technical journals, conferences, advertising, exhibitions, word-of-mouth advertising, through distributors or by typing a keyword into an internet search engine. Any of these promotional tools can attract the customer's attention. The subelements of promotion can, therefore, be modelled

as a 'redundancy structure',²⁵ shown in Figure. The subelements are divided in four groups: virtual promotion, active promotion, technical publication and promotion through a third party.

Based on Birolini (1994),²⁶ the following expression for the corresponding probability function of promotion P_1 is derived:

$$\begin{aligned}
 P_1 = & P_{11} + P_{12} - P_{11}P_{12} + P_{13} + P_{14} \\
 & - P_{13}P_{14} - P_{11}P_{13} - P_{11}P_{14} \\
 & + P_{11}P_{13}P_{14} - P_{12}P_{13} - P_{12}P_{14} \\
 & + P_{12}P_{13}P_{14} + P_{11}P_{12}P_{13} \\
 & + P_{11}P_{12}P_{14} - P_{11}P_{12}P_{13}P_{14}, \quad (7)
 \end{aligned}$$

Figure 4 Subelements of the marketing 4P promotion block: any of the elements can grab the customer's attention

where P_{11} is the probability of success of virtual promotion, P_{12} is the probability of a successful active promotion, P_{13} of attracting a customer by a technical publication, and P_{14} of the promotion through a third party.

Active promotion, including advertising, exhibitions, phone calls and email promotions are one-time activities, the impact of which does not last long. In contrast, the work invested in the other forms of promotion can be accumulated; for example, published papers in technical journals or conference proceedings can be found after years in the libraries; the word-of-mouth advertising is proportional to the accumulated number of customers; the work invested in the improvement of a website gets accumulated, etc.

Some of the promotion subelements in Figure 4 are limited by place. For example, exhibitions and conferences take place in defined areas, and therefore the customer's access is limited. In addition, the promotional tools of advertising and technical papers are restricted by place, because the language

of the journals is already defined and therefore published in corresponding geographical areas. The only promotional tool with worldwide access is the internet, as the customer can obtain detailed information on the start-up's offerings regardless of the geographical area or time. Today's promotional tools, therefore, often explicitly mention the company's website.

Once the customer's attention is attracted, they will seek detailed information. In most cases the customer visits the company's website.²⁷ The start-up's website enables a potential customer to obtain detailed information on the product and the company.

Product: the customer's solution

Levitt's model of the whole product,²⁸ shown in Figure 5, plays a significant role in high-tech marketing, according to Davidow.²⁹ The model includes the generic product, expected product, augmented product and potential product. The basic idea behind Levitt's model can be interpreted as to increase

Figure 5 Levitt's whole product model: the model includes the idea of the generic product, expected product, augmented product and potential product

the probability that a customer buys a product.

In order to include Levitt's product model into the present consideration, Figure 5 is transformed into a probability block diagram (Figure 6). The subelements in the product block diagram, Figure 6, correspond to the elements of the whole product model. By accessing the start-up's website the customer may evaluate the product's data sheet. This is analogous to the generic product. Then the customer may be interested in the application notes, which is analogous to the expected product, or the customer may directly ask for support, which corresponds to the idea of the augmented product. The customer may also ask for custom design, which is analogous to Levitt's potential product.

The probability function P_2 of the product block can be expressed as:

$$P_2 = P_{21}P_{23} - P_{21}P_{22}P_{23} + P_{21}P_{22}^2P_{23} + P_{21}P_{22}P_{23}P_{24} - P_{21}P_{22}^2P_{23}P_{24}, \quad (8)$$

where P_{21} is the probability that a customer is satisfied with the characteristics of the generic product (data sheets), P_{22} the probability of buying application notes, $(1 - P_{22})$ the probability of not buying application notes, P_{23} the probability that the

customer decides to accept support, and P_{24} that they look for a custom-designed module.

The customer evaluates the product block on the start-up's website. It is, therefore, important that the site is easy to use and self-explanatory. This phase in the customer's decision process has the highest efficiency-cost ratio for the start-up. The costs are low, because the internet is a self-service marketing tool. In addition, it is accessible to customers at any time and place.

Price: reduce customer's costs but generate revenue

The price that the customer is ready to pay depends on the leverage rate of the purchased solution,³⁰ which includes the difference between total customer value and total customer cost. According to Kotler,³¹ the total customer value includes product value, service value, personnel value and image value. The total customer cost includes monetary costs, time costs, energy costs and psychic costs. This can be transformed into a block diagram (Figure 7). The probability that the price suits the customer depends on the delivered value, and it has to be better than the competitive value.

Figure 6 Simplified flow diagram of the subelements of the marketing 4P product block: the idea of Levitt's whole product model is transformed into a probability block diagram

Price is the most flexible element, so that the start-up can adapt it according to the situation. In order to increase the probability that the price is acceptable for the customer, the start-up has three possibilities.³² First, increasing total customer value by improving product, services, personnel and/or image. Secondly, reducing the buyer's nonmonetary costs by lessening the time, energy and psychic costs. Thirdly, reducing the product's monetary costs.

The monetary costs of the product can be reduced by the production quantity: cost per unit is a function of accumulated production experience. This function is called the learning curve.³³ The value of the product, service and personnel usually increases with time, because the quality is proportional to the start-up's accumulated know-how in the field of its core competence. The value of the image increases in proportion to the number of sold units. The nonmonetary costs (time,

energy and psychic costs) can also be reduced by time: the start-up accumulates know-how on how to provide the product to a customer to reduce their effort in understanding and applying the product.

The probability function P_3 that the price suits the customer is:

$$P_3 = P((\text{value} - \text{costs})_{\text{Start-up}} > (\text{value} - \text{costs})_{\text{Competitor}}). \quad (9)$$

P_3 is the probability that the start-up's delivered value to the customer is greater than the competitive value.

Place: accessing the product

By definition, place includes all marketing channels,³⁴ for example, the start-up's website and location, and it also includes activities, for example, readiness to deliver off the shelf, to make the product accessible and available to target

Figure 7 The price element of the marketing mix: the price that a customer is ready to pay depends on the net value they receive from purchasing a product

customers. Place also includes communication with likely customers, personal contacts, which depends on the time difference of geographical areas, free samples delivery, etc. To simplify this, just a few key elements will be mentioned in Figure 8. Customer visits are important for efficient and successful negotiations in sales. The visits can be performed by the start-up's staff or by representatives and distributors. A further key element is the start-up's readiness to deliver at the moment the customer wishes. These subelements are shown in a block diagram in Figure 8.

The probability of place P_4 can be expressed as:

$$P_4 = P_{41}P_{43} + P_{42}P_{43} - P_{41}P_{42}P_{43}. \quad (10)$$

P_{41} is the probability of successfully performed direct customer visits and P_{42} visits performed by representatives and distributors. P_{43} is the probability that the distribution is convenient for the customer.

BUYING PROBABILITY AND MARKET SHARE

As previously mentioned in Equation (5), the total probability function P is the product of all single probabilities: $P_1 P_2 P_3 P_4$. The aim of any start-up is to increase the total probability P , which is to increase the probability of success of the customer's buying-decision process. It will now be shown that this is analogous to Kotler's statement that the aim of any selling concept is to increase the market share.³⁵ To this end, both the numerator and the nominator of Equation (6) can be extended by a factor $\overline{V_{CY}}$:

$$P = \frac{N_{\text{buy}} \cdot \overline{V_{CY}}}{N_{\text{tot}} \cdot \overline{V_{CY}}}. \quad (12)$$

$\overline{V_{CY}}$ is the average value per customer and year. Remember that N_{buy} is the number of the start-up's customers who buy the product, and N_{tot} is the number of customers on the total market, who could, in principle, use the start-up's

Figure 8 Place incorporates the customer's convenience of accessing the product; this includes direct customer visits, visits through representatives and distributors, start-up's readiness to deliver, etc

solution. $N_{\text{tot}} \times \overline{V_{CY}}$ directly gives the total market volume:

$$M_{\text{tot}} = N_{\text{tot}} \overline{V_{CY}}. \quad (13)$$

and $N_{\text{buy}} \times \overline{V_{CY}}$ is the start-up's sales, which corresponds to the start-up's absolute market share:

$$S = N_{\text{buy}} \overline{V_{CY}} \quad (14)$$

Substituting (13) and (14) into (12) obtains:

$$S = P \cdot M_{\text{tot}}. \quad (15)$$

Therefore, the probability P also describes the part of the total market M_{tot} being served by the start-up company. Usually, for a start-up $0 \leq P < 1$. Converting Equation (15) obtains:

$$P = \frac{S}{M_{\text{tot}}}. \quad (16)$$

Evidently, the probability P is the start-up's relative market share.

AN EXAMPLE

This section will give an example on how to calculate some of the probabilities appearing in the model. This example is based on the data of a small Swiss company, Sentron AG,³⁶ which has been commercialising its new Hall Sensor Microsystem since September 2002. For easy reference, the findings will be added to the model previously shown in Figure 3, see Figure 9.

All customers (N_{tot})

Rough market research obtains that $M_{\text{tot}} \approx \$650$ Mio. These data are based on an evaluation of the primary Hall Sensor providers, listed in the book *Hall Effect Sensors*.³⁷

The mean quantity of sensors obtained by each customer per year and the mean price per sensor were obtained using customer contacts. So, for the average value per customer and year $\overline{V_{CY}} \approx \$133,000$ is obtained.

Figure 9 An example of the model using data from Sentron, where the number of total potential customers, N_{tot} and the probability of a successful evaluation of the product, P_2 were evaluated

Converting Equation (13) obtains:

$$N_{\text{tot}} = \frac{M_{\text{tot}}}{V_{\text{CY}}} = 4,887 \text{ customers/year} \quad (17)$$

As shown in Figure 9, the result of Equation (17) is the number of all customers who, in principle, could use the start-up's new sensor.

Potential customers (N_{pot})

Using statistics from the Sentron website, calculations were made to derive the number of customers who successfully learned about the start-up's new sensors, N_{pot} (Figure 10). The first bar 'Sentron'

in Figure 10 describes the number of customer page views of Sentron's entry website: 1,000 page views per month. From this number, it was possible to derive the number of potential customers (N_{pot}), who successfully learned about Sentron's new product and therefore visited Sentron's website for more information. Unfortunately, there is no information about the number of customers who visited the page more than once.

Matching customers (N_{match})

The probability that the customers' requirements match with the start-up's

Figure 10 Sentron's website statistics for the month June, 2003: each bar shows the number of page views on a certain page: for example, 'Sensors', 'Support', 'Application Notes', etc

product (P_2) could be approximately estimated based on the numbers in Figure 10. To illustrate the findings better, the numbers of page views of Sentron's webpages 'Sentron Entry Page', 'Application Notes', 'Support', 'Custom Made', and 'Contact' are added to the flow diagram previously shown in Figure 6: see Figure 11.

It is now possible to calculate the probability of success (P_2) of the customers' evaluation process of the product block:

$$P_2 = \frac{148 \text{ customer/month}}{1000 \text{ customer/month}} = 0.15 \quad (18)$$

Unfortunately, the structure of the analysed website does not support the collection of more precise data on the efficiency of the important elements of the model in terms of marketing and sales process.

OPTIMISING SPENDING IN MARKETING AND SALES

Each P -element in the start-up's marketing mix requires investment.

Investment in some of the subelements accumulates over time, others are more like costs: they require permanent spending. The question now arises how to allocate the investment and costs in each element of the marketing 4Ps to optimise the commercialisation process of high-tech start-up products.

As the total probability P is defined by the product of all particular probabilities, as shown in Equation (5), the aim is to find the maximum for this product with a given budget.

Allocation of spending

Increasing the probability of success in attracting customer attention requires investment in promotion. As described previously, there are one-time activities, such as advertising or exhibitions, and accumulated investment in technical papers, websites and word of mouth. In the early phase of the company, investment in activities that can be accumulated is crucial: for example, investment in the design of the company's website. One-time investment,

Figure 11 Simplified flow diagram of the product element of the marketing mix: the labels show the numbers of customer page views of Sentron's pages 'Sentron Entry Page', 'Application Notes', 'Support', 'Custom Made', and 'Contact' for the month June, 2003

for example, advertising, is valuable if the aim is to announce completely new products, or to refresh the memory of existing customers.

Product is the basic element of the marketing mix. Investment in product development was already done. Additional investment in product is to increase the probability of a perfect match between the product and the customer's needs. This includes investment to improve the data sheets, application notes, customer support from sales engineers and custom-designed solutions. This was derived from the idea of Levitt's whole product model. All investment in the marketing product block can be accumulated: data sheets and application notes can be published on the internet. If the information is complete and self-explanatory, the start-up can achieve a high efficiency-cost-ratio. The costs of the customer support also have the function of an investment in acquiring valuable intelligence on customer needs and

problems. Investment in custom-designed solutions can also be beneficial for the start-up: through development orders the start-up may accumulate know-how in the area of its core competence.

The price that a customer is ready to pay depends on the leverage rate of the purchased solution. However, in their evaluation phase of the buying-decision process, customers are sensitive to the attribute price and compare it with the competitive product prices. As a rule, a start-up's new product is expensive because it is produced in small quantities. Investment in the price element may mean to set a price which is lower than the start-up's costs in order to increase the probability of 'crossing the chasm'³⁸ from early markets to general markets. The following two conditions favour setting a low price: (1) the market is highly price-sensitive, and (2) production and distribution costs fall with accumulated production experience.³⁹

Investment in the place element is to increase the customer's convenience to

access the product. This includes for example, the start-up's readiness to deliver products off the shelf, which requires investment in the stock of products. It also requires investment in time and money for personal customer visits — and this is not an investment that can be accumulated. The pre-selection of likely customers that really match is, therefore, crucial in order to optimise the investment and concentrate on visits of future lead customers.

Allocation of spending vs company growth

Allocation of investment in the particular marketing mix elements varies by the phase of the company development. In the early phase of a self-financed company, the only thing that the company can sell is R&D service or intellectual property. At this time the company has no image, no production and no established distribution channels. So, the most efficient allocation of investment is in product, ie intellectual property, and in parts of promotion that can be accumulated (eg technical publication and website). Word-of-mouth advertising also starts in this phase.

In the next phase, when the start-up company starts selling first product units to its lead customers, the early production starts. The earlier it starts, the faster the accumulation of the production learning curve and the lower the costs per unit. This affords faster sales, which can be achieved through following activities: (1) aggressive advertising and exhibitions, and (2) active sales engineers who select the perfect matching customers: these are customers who order quickly and who order products that do not require additional application developments.

It is possible to conclude that investment optimisation in the marketing mix elements to increase the probability

of success in terms of the customer's buying decision is a dynamic process that varies as a function of the maturity of the company and the development phase of its product.

CONCLUSIONS

The process of finding solutions for a problem faced by potential customers of a start-up company can be modelled as a series of partial customer decisions. After each phase of the evaluation process, the customer decides either to continue the evaluation or to look for another supplier. In order to serve the customer, a supplier adapts its marketing and sales process — the marketing mix — to correspond well to the customer's buying process. Therefore both the customer buying process and the company selling process can be modelled in the same way. This is corroborated by Lauterborn's idea, that the seller's 4Ps (promotion, product, price, place) correspond to the buyer's 4Cs (communication, customer solution, customer costs, convenience), as mentioned previously.

This study ascribes a probability of success to each element of the marketing 4Ps. Now, the 4P-elements can be treated as independent events, according to the theory of probability. Then, the total probability of success of the customer's buying-decision process is obtained as a function of the seller's 4Ps. It is also shown that the total probability of the sales process is equal to the start-up's relative market share.

The structure of the customer buying-decision process is analogous to the reliability block diagram used in engineering. This direct analogy makes it possible to apply the whole existing methodology to calculate the probabilities of events in a complex system. In particular, the probability can be calculated at different hierarchical

levels of the block diagram. This implies a qualitative analysis to identify whether or not the subelements of the 4P-blocks are redundant (eg see Figure 6).

This study provided an example on how to calculate some of the probabilities appearing in the model by using the statistics of customer visits to a start-up's website. It was found that the structure of the website analysed does not support the collection of more precise statistics on the efficiency of the important activities in the sales process. This leads to the conclusion that one of the criteria of the design of an efficient website should be what engineers call testability and measurability. A 'measurable' and 'testable' sales-oriented website — according to the model — should allow a good control of the sales system in the sense of the control theory.

Based on the process flow diagram, this paper has discussed the allocation of spending in the marketing mix in order to maximise the probability of success. This step opens the door to further research and suggests the following: if the functional dependence of costs of each subelement of the marketing mix could be found, then the allocation of investment in the marketing and sales process could be mathematically optimised in order to achieve the maximal total probability of success of the customer's buying decision by a given budget.

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