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**The Effects of Competition and Costs  
on Demonstration Strategies  
in the Software Industry**

**by**

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# **The Effects of Competition, Costs, and Consumers' Choice on Demonstration Strategies in the Software Industry**

## **Abstract**

In the software industry, the need to provide a mechanism that enables the prospective customer to experience the product before the final purchase increases as a result of the increase in competition and the technical complexity of the product. As a result a demonstration offer is becoming an integrated part of any software sales effort. Software demonstrations vary in length (duration) and personalization level. With the increase in the popularity of the Internet, the tendency to use it as a vehicle for providing information about the product also increases. This includes a demonstration provided via the Internet. The special characteristics of the Internet dictate the demonstration's character, i.e., all programs are self-installing and directly experienced, yet vary in their duration and usage restriction levels.

Software products which require either installation or training, cannot be demonstrated via the Internet, and require a personalized demonstration, which due to its high cost, is usually shorter than the average Internet demonstration.

In this paper, we model the effect of competition and cost structure—in particular the difference between personalized and impersonalized (Internet) demonstrations—on the demonstration's strategy.

This paper shows that if the demonstration is personalized, then a competitive firm tends to decrease both the number of demonstrations and the duration of each. If the software product is demonstrated via the Internet, then the decision about quantity of demonstrations is not relevant, and the decision regarding the demonstrations' duration depends on the intensity of competition. In a highly competitive market, when an increase in the demonstration's duration increases the probability of inclusion in the evaluation set, then competition will cause an increase in the duration of each demonstration. If the demonstration's duration does not contribute to the probability of being tested, then competition will decrease the demonstration's duration.

We support the theoretical findings empirically using data collected from two software industries, each with a different demonstration cost structure: software demonstrated via the Internet, and industrial software products, the latter which require personal demonstrations. Software products that are distributed via the Internet represent the industry whose cost of providing a demonstration is the alternative income loss. Analysis of the empirical data indicates that in general, the duration of a demonstration is negatively related to the price of product and the number of competitors. However, there are some sub-industries wherein competition increases the duration of a demonstration, indicating that duration has an effect on the probability of the product's being tested. Industrial graphical software was found to be an industry where demonstrations are personal, and thus demonstration cost is a function of both the number and duration of demonstrations. In the industrial market, we show that the number of demonstrations decreases with competition.

# **The Effects of Competition and Costs on Demonstration Strategies in the Software Industry**

## **1. Introduction**

In today's business environment, it is rare to find a software sales effort that is not accompanied by a demonstration of the software. Demonstration, free trials, evaluation copies, or software test-drives all exemplify a mechanism which enables the potential customer to try a product before purchasing it. Demonstrations vary among companies and between different products of the same company in many aspects, such as the place where the demonstration is held and restriction on usage during the trial.

Software products which is distributed via the Internet are classified into three groups: freeware, shareware, and demos.

Freeware is software products which are distributed free of charge for an unlimited period of time. Examples of freeware are the basic versions of Eudora, Netscape, and Explorer.

Shareware is commercial software products which can be used for a limited time free of charge, usually 30 days. The limited usage time is defined as an evaluation period after which the consumer must purchase it.

Demoware, or demos, are either a restricted (demo) version of a commercial software, or fully operating software which can be experienced for a limited period of time. Although the average evaluation time is 30 days, there are many software distributors who offer their software products for a shorter or much longer period of time. Some products, such as Windows 98 or Office 2000, are not offered for trial at all. Others, such as simulation or statistical packages, are offered for a wide range of time

periods. Systat (a statistical package) demonstrates its product for 60 days, JobTime for three days, and FMS for 30 days (the latter two are simulation software).

The firms in these examples employ varied demonstration strategies regarding the duration of the demonstration trial period only, while the number of demonstrations distributed is not controlled, i.e., anyone with access to the Internet can take advantage of these free trial offers.

In other cases, the marketers choose to control both the duration and the number of demonstrations, such as Microsoft's NT server, which was offered for a 60-day free trial period (Johnston, 1994). Microsoft's demonstration policy hints that the same firm may utilize different demonstration strategies for different products depending on the intensity of competition. When Microsoft dominates the market, then demonstrations are not offered at all (Office, Windows operating system).

In markets where competition is heavy, Microsoft has offered demonstrations (Microsoft's NT server) and when the market was dominated by other firms, freeware was offered (Explorer in a market ruled by Netscape). The variety of demonstration policies of various firms in the same market, and of the same firm in different markets, needs to be understood better.

Demonstration in durable products and sampling in consumables is an under-researched area in general, and lacks any competitive analysis in particular. Heiman and Muller (1996), who modeled the optimal duration of a demonstration, and Jain, Mahajan, and Muller (1995) who modeled product samples, did not incorporate competition into their analysis.

In this paper we model the effect of competition and cost structure, particularly the difference between personalized and impersonalized (i.e., Internet) demonstration,

on a demonstration's strategy, when competition intensity increases. Our main findings are that if the cost of demonstration is a function of its quantity and duration, then a competitive firm tends to decrease both the number of demonstrations and the duration of each.

If the cost of providing a demonstration is the alternative income loss, then the result depends on the effect of the demonstration's duration on the probability that a consumer will choose the product for her evaluation set. If the duration increases the probability of being evaluated, then competition increases the duration of the demonstration. If duration has no effect on testing probability, then competition decreases duration.

The paper is organized as follows: In the next section, we review the product and the consumer characteristics, and in Section 3, consumers' choices are formulated. Section 4 models the firm's optimal behavior, while Section 5 analyzes behavior under various competitive structures, cost structures, and consumer characteristics. Section 6 illustrates our results via an empirical study, and Section 7 concludes the paper.

## **2. Product and Consumer Characteristics**

When purchasing a product, the consumer is usually uncertain about the outcome of his choice. Product performance may not meet the consumer's expectations; the product may work well, but not match the consumer's subjective needs; the product may be subject to negative response from the consumer's reference group; finally, the product may depreciate in value more rapidly than expected. Note that all of these undesirable outcomes may occur separately or together, and may apply to a smaller subset of the relevant attributes of a product (see Rathneshwar, Warlop, Mick, and

Seeger, 1997).

In order to cope with these uncertainties, consumers employ various methods of risk reduction. Some of these methods involve loyalty to a specific familiar brand, choosing high-priced brands (Mahajan, Rao, and Srivastava, 1994), purchasing with a money-back guarantee, or trying the product before purchasing (for a detailed discussion of the choice demonstration versus MBG, see Heiman, McWilliams, and Zilberman, 1999).

Regarding durable goods, one of the most effective ways to try a product before purchasing it is by using a demonstration, which allows the consumer to gain experience with the product's performance without making a commitment. Regarding consumables, product samples play the same role as demonstrations, but the optimization variables differ, and the focus is on the change of optimal sampling over time (see Jain, Mahajan, and Muller, 1995).

Since demonstrations provide consumers with more information prior to purchase than they would have otherwise, demonstrations reduce the purchasing risk, thus possibly increasing the probability of purchase at a given price. Viewing the main role of demonstration as an information provider follows the Heiman and Muller (1996) modeling approach and differs from earlier studies, which viewed demonstration mainly as a promotional accelerator (see Freedman and Fraser, 1966; Pliner, Hart, Kohl, and Saari, 1974; and Scott, 1976).

Heiman and Muller (1996) suggest that the amount of time required to learn various product attributes varies from attribute to attribute. Consumers can learn some attributes' performance relatively quickly, while others can be learned only if the consumer invests a considerable amount of time. Still other attributes are learned only

after extensive use. For example, in many software products, consumers can evaluate the friendliness of the software quite quickly, while some functions, such as compatibility with other software products, can be evaluated only after more time is invested.

The longer the duration of the demonstration, the more a consumer can learn about the product's performance. However, a longer demonstration period also means higher costs for the manufacturer. As it is reasonable to assume that consumers adapt their search and product processing according to the value and cost of information (see Weiber and Adler, 1995), it is also reasonable to assume that some consumers with high time costs will use the demonstration for only part of the time offered.

Prior knowledge or experience can shorten the time needed for product evaluation. Lack of experience not only increases the time required for evaluation, but can also lead to misjudgment. Lutz (1986) suggested that the higher the consumer's ability to evaluate the product's performance before buying it, the more likely the consumer's judgment is to be cognitive rather than affective. In addition, it was found that consumers with high prior knowledge evaluate each attribute and the product's overall performance level faster (see Steenkamp, 1990 and Sujan, 1985). Nevertheless, this finding does not mean that experienced consumers' uncertainty is lower regarding the product's ability to fit their needs (see Johnson and Russo, 1984 and Sujan, 1985).

In the following section, we model the consumer's decision when faced with a product that is demonstrated, and the informative role demonstration that plays in the consumer decision process.

### 3. The Consumer's Choice

Before buying a product, a consumer collects information from various sources, such as word-of-mouth information, advertising, and the retailer. The obtaining of information from these sources can all be characterized by the passive role the consumer plays, and her limited ability to obtain the desired direct information. All of these information sources may help create attitudes toward the product that together become the consumer's pre-demonstration purchasing probability.

Products are designed and manufactured for representative individuals from a specific consumer target group. Assume that a product is manufactured with a given design. A consumer will benefit from using the product if his specifically desired design falls into the product's target range of this design.

A consumer may have some preconceptions regarding the average design of a particular product, and may also have some idea about the product's average flexibility of design for her idiosyncratic needs, but is unable to predict precisely whether or not these specific needs will be satisfied by the product, since they are unknown to the manufacturer. Even if the manufacturer possessed knowledge of this consumer's specific needs, products are designed for a *segment* of consumers, and not for a particular individual.

This imperfect knowledge regarding the performance and personal fit of the product to a consumer's needs generates pre-purchase uncertainty, and product demonstration is perhaps the most efficient way to reduce it. In the software industry, demonstrating the product has become a must, with the following quotation perhaps illustrating this principle best:

“Thank you for taking the time to evaluate Systat 8.0’s demonstration software. We realize it is not always possible to get a complete understanding of a software product’s features and capabilities by reading a brochure. That is why we have provided the demonstration version. As scientists ourselves, we know the importance of being able to evaluate software relative to your specific requirements”.

Product demonstration provides the consumer with some information, even if he chooses not to participate actively, since it signals to him that the product performs adequately. This information, however, does not resolve the average consumer’s uncertainty, since the determination of whether or not the consumer’s subjective needs will be met, are not conveyed in this signal.

In generalized, or non-personal demonstrations, the software firm alone determines the duration of the demonstration. In personal demonstrations, the duration of the demonstration may be a function of some negotiation, but in-depth interviews suggest that the influence of the consumer on a demonstration’s duration is quite limited. Thus we model a demonstration’s duration in both cases as the firm’s decision.

Demonstrations are costly to consumers, and thus are effective only if the cost to the consumer of using the demonstration is assumed to be smaller than the gain of risk reduction. If more than one demonstration is offered, the consumer will test the candidate products serially (one after the other), and if she finds that the first product tested is a match, she will not still continue on to the second product. This modeling approach is consistent with the earlier work of Grossman and Shapiro (1984). When competition is intense, it is reasonable for the consumer to first choose a sub-set of competitors (evaluation set), and then choose the first firm whose product she will try out.

After trying the product, consumers update their beliefs regarding the performance and fit of the software, and, using this posterior evaluation, reach the purchasing decision. Consumers are assumed to purchase the product only if they predict that the product is a match. Consumers are heterogeneous in their needs, and thus some of them end the process of demonstration with the decision to purchase the product, and some do not.

In addition, it is assumed that manufacturers do not have any mechanism that will enable them to distinguish among consumers based on consumers' sets of subjective needs. Thus, manufacturers cannot predict the individual probability of purchase, and so relate only to average purchasing probability. From the manufacturer's point of view, the probability that an average consumer will buy the product is

equivalent to the probability that an average consumer will predict that the product is a match<sup>1</sup>.

Before trying out the product, consumers have prior perceptions regarding the degree of suitability of the product to their needs. These priors yield an initial purchasing probability. Let  $t$  represent the duration of demonstration, and  $K$  represent the purchasing probability with perfect knowledge i.e.,  $t = \infty$ . Assume that  $h$  percent of those consumers who would purchase the product with perfect information will not purchase it without experiencing the product. Thus,  $K(1-h)$  represents the average initial purchasing probability without experiencing the product i.e., for  $t = 0$ . Obviously, any demonstration offer falls in the range of  $0 < t < \infty$ , and thus the corresponding purchasing probabilities will be in the interval  $((1-h)K, K)$ .

As argued previously, experiencing the product causes consumers to update their prior beliefs. The dynamics of Bayesian belief updating means concavity of purchasing probabilities with regard to the duration  $t$  between the upper and lower boundaries ( $K$  and  $K(1-h)$ ). Any exponential function of the demonstration time  $t$ , and in particular  $K(1 - h e^{-rt})$ , where  $r$  represents the speed of learning, satisfies this condition.

#### 4. The Firm's Optimal Behavior

This paper models the effect of competition and cost structure on demonstration-related decisions, and thus it cannot cover the freeware market. The logic of demonstrating is to enable the prospective customer to experience the same product that

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<sup>1</sup> Alternatively assume that  $\alpha$  percent of those who predicted the product is a fit buy the product. In this case the expected revenue gain will be lower in  $(1-\alpha)$ , but the optimal values under competition will not be affected (both sides are multiplied by  $(1-\alpha)$ ).

she intends to purchase. In contrast, the motivation for distributing freeware is the creation of usage habit and the reduction of usage cost, which in turn creates a cost for future product change (see McWilliams and Zilberman, 1996 for an excellent discussion of a similar modeling approach i.e., “Learning by Using and Learning by Doing”).

The revenue from a software sale is composed of two components - the first is a fixed price and the second is a function of usage time, formally,  $(P_0 + wT)$ , where  $w$  is the per-day usage fee. Daily or per-use payment is a practice in the business of many online providers, such as AOL and electronic journal subscriptions. If the software life cycle is short, then the license payment can be viewed as per-day usage.

Anticipated revenue depends on the number of buyers, which is the sum of customers who purchase the product without a demonstration plus those who purchase it after a demonstration.

In the case of a monopoly, the number of buyers equals to the number of demonstrations offered with the probability to buy after a successful demonstration, multiplied by the probability to buy i.e.,  $n_1 K_1 (1 - h e^{-rt_1})$  plus the number of individuals who choose buy the product without having a demonstration,  $(N - n_1) K_1 (1 - h)$ .

We assume that competition does not increase market size and thus the effect of demonstrations, which are offered by a single firm in a duopolistic market structure, is weakened relative to their effect in a monopolistic situation. This assumption is borne out, since in a non-monopoly, a potential consumer may receive a demonstration from the competing firm, and a certain probability exists that he will prefer the rival's product.

For simplicity's sake, we do not model the effect of price differences on purchasing probabilities. However, the difference in quality and reputation which is reflected in the pre- and post-demonstration purchasing probabilities between rivals, is covered in the comparative static analysis.

A consumer will purchase the demonstrated product from the first firm if: a) she likes this firm's product, and b) she either did not receive a demonstration from the second firm, or received a demonstration from the second firm but did not like it. Therefore, the purchasing probability of the single firm is multiplied by the probability that a random consumer will either not receive a demonstration from the rival,

$\frac{n_1}{N} (1 - \frac{n_2}{N})$ , or obtained a demonstration from the other firm but decided not to

purchase its product,  $\frac{n_1 n_2}{N^2} (1 - K_2 (1 - h e^{-rt_2}))$ .

The cost of offering demonstrations is a function of the type of demonstration, as described in Table 2. We cover the various possible cost structures in a nested model, and analyze the various cost scenarios by setting some of the cost coefficients at zero.

Let  $C_1$  represent the fixed cost coefficient of providing each demonstration, and let  $C_2$  be the cost coefficient of the duration component. In short life cycle products, we have in addition to these two cost elements, the cost of income loss, denoted by  $w$ , which is the multiplication of the demonstration duration by the daily usage fee.

When the demonstrator optimizes the demonstration's duration, the question of whether or not the prospect will use the entire demonstration duration is not relevant. This is true, since if the prospective customer decides that the product is a match before the expiry of the demonstration's duration, she will nevertheless continue to use it for

the entire free usage period. On the other hand, if the consumer does not find the software to his liking and quits the demonstration before it expires, the issue of income loss is not relevant, since that consumer would not buy the product no matter what the demonstration duration.

Table 1 summarizes the effects of the two strategic variables of duration and number of demonstrations on the costs of the firm.

**Table 1: The effects of duration and number of demonstrations on costs**

	<b>Duration does not affect demonstration costs</b>	<b>Duration affects demonstration costs</b>
<b>Number of demonstrations does not affect costs</b>	<b>Type 1:</b> <i>No variable costs</i> <b>Example:</b> limited version of software distributed on diskette or via the Internet. <b>Costs:</b> $C_1=0, C_2=0, w=0$	<b>Type 2:</b> <i>Costs are associated only with the length of the demonstration.</i> <b>Example:</b> Self-experienced, unrestricted version, but for a limited time, accompanied by training or telephone support <b>Costs:</b> $C_1=0, C_2 \geq 0, w \geq 0$
		<b>Type 3:</b> <i>Costs are associated only with income loss.</i> <b>Example:</b> Software products which are downloaded from the Internet and come without training or support <b>Costs:</b> $C_1=0, C_2 = 0, w > 0$
<b>Number of demonstrations affects</b>	<b>Type 4:</b> <i>Costs are a function of the number of demonstrations, but not of their length.</i> <b>Example:</b> short personal demonstration without post-evaluation free trial period. <b>Costs:</b> $C_1>0, C_2=0, w=0$	<b>Type 5:</b> <i>Costs are associated with the length and the number of demonstrations.</i> <b>Example:</b> Industrial software, which requires installation and training (lasting several hours to several days). After training, the software is left at the customer's site for further evaluation. <b>Costs:</b> $C_1>0, C_2 > 0, w > 0$

The cost elements which are a function of the number of demonstrations are site installation, shipping and handling costs, cost of materials such as diskettes and training

literature, and travel expenses of the sales associate. In cases of on-site installation and / or travel expenses, it is reasonable to assume that the demonstration's fixed cost element is linear; otherwise it may be an increasing function of the number of demonstrations conducted.

Increasing installation costs evolve from the marginality of the expected sales motivation, i.e., initial sales efforts are targeted at close geographical areas or areas with high concentrations of potential customers, or to the most promising customers. Only when these areas or segments are fully covered does the sales associate move on to target less promising customers, who may be located at more distant locations.

As a result of these considerations, the cost of reaching additional customers increases, leading to a convex cost structure. We can model the fixed cost as linear, or as an increasing function of the number and in particular  $C_1 n^2$ . Since quadratic cost forms are more reasonable, and yield more interesting results, we prove all of our propositions using this form. However, we also present the results for the linear case, although such results are not proven formally<sup>2</sup>.

Regarding costs associated with length of demonstration, it is reasonable to assume that they are a linear function of the sum of individual demonstration lengths (the duration of each demonstration multiplied by the number of demonstrations).

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The mathematical results of the linear case can be obtained from the authors.

## Optimal Demonstration Policies

The single-firm profit function in a monopolistic market structure is represented by:

$$\pi^m = (N - n_1)K_1(1 - h) + (P_0 + w(T - t))n_1K_1(1 - he^{-rt_1}) - C_1n_1^2 - C_2n_1t_1$$

The single-firm profit function in a duopolistic market structure is represented by:

$$\pi^D = \left(1 - \frac{n_1}{N} - \frac{n_2}{N} - \frac{n_1n_2}{N^2}\right)Nf(K_1, K_2, h) + (P_0 + w(T - t))K_1(1 - he^{-rt_1}) \left[ n_1 \left(1 - \frac{n_2}{N}\right) + \frac{n_1n_2}{N} (1 - K_2(1 - he^{-rt_2})) \right] - C_1n_1^2 - C_2n_1t_1$$

Where  $\left(1 - \frac{n_1}{N} - \frac{n_2}{N} - \frac{n_1n_2}{N^2}\right)Nf(K_1, K_2, h)$  is the number of consumers who did attend

demonstration but will purchase the product from the first firm.  $f(K_1, K_2, h)$  is the probability that a consumer who did attend demonstration will purchase the product from the first firm

The first-order condition with respect to the length of each demonstration offered for the single firm in the monopolistic market structure is:

$$\frac{\partial \pi^m}{\partial t_1} = -wK_1(1 - he^{-rt_1}) + (P_0 + w(T - t))K_1rhe^{-rt_1} - C_2 = 0$$

The marginal gain in revenues is decomposed from the increase in the probability of purchase of the product (uncertainty reduction) multiplied by the product's price and loss due to free usage. The optimal duration of a demonstration in a monopolistic market increases with the product's fixed price  $P_0$ , the full information purchasing probability  $K$ , the anticipated life cycle of the product  $T$ , and the percentage of consumers who would purchase the software with perfect information, yet choose not to purchase it without experiencing it,  $h$ .

Optimal demonstration duration decreases with the speed of learning  $r$ , and the

cost per time unit . The effect of an increase in the variable price component  $w$ , can be either positive or negative. An increase in  $w$  increases the expected benefit of the additional sales, but it also increases income loss and thus the magnitude of the change depends on the mixture of other coefficients.

$K$  (the upper boundary of the purchasing probability) reflects the software's quality. The lower boundary of the purchasing probability reflects the reputation of the firm as well as word-of-mouth information, i.e., the stronger the pre-trial confidence in the product, the lower  $h$  is, and the lower the need to provide demonstrations.

The first-order condition with respect to the length of each demonstration offered for the single firm in the duopolistic market structure is:

$$\frac{\partial \pi^D}{\partial t_1} = \left[ -wK_1(1 - he^{-rt_1}) + (P_0 + w(T - t))K_1rhe^{-rt_1} \right] \left[ n_1 \left( 1 - \frac{n_2}{N} \right) + \frac{n_1 n_2}{N} (1 - K_2(1 - he^{-rt_2})) \right] - C_2 n_1 = 0$$

The first-order condition of the single firm in the duopolistic market structure is identical to the one obtained by the monopoly, except for the argument

$\left[ n_1 \left( 1 - \frac{n_2}{N} \right) + \frac{n_1 n_2}{N} (1 - K_2(1 - he^{-rt_2})) \right]$ , which is smaller than 1, and reflects the intensity of competition. Therefore, the same factors which influence the demonstration duration of the monopolistic firm also influence the demonstration duration offered by the single firm in the duopolistic market structure. In addition, all factors that increase the power of the rival also decrease the productivity of the demonstration, and thus decrease the duration of the demonstration. Thus, if the rival firm increases the number of demonstrations or their duration, the first firm will decrease the duration of its demonstration.

A long demonstration can imply that the firm has high-quality software (high  $K$ ), but it can also be the outcome of a low initial number of adopters, low demonstration

costs, and slow-learning software. Thus, the duration of a demonstration does not in itself convey enough information about the product, and in order to learn more, the consumer needs to experience it.

It is easy to see that the optimal duration of a demonstration is not a function of the optimal quantity (number) of demonstrations, and thus it is appropriate to compare the first-order conditions of the single firm in both monopoly and duopoly market structures. Comparing first-order conditions with respect to the demonstration's length in both market structures yields the following proposition:

**Proposition 1**

**If the variable cost of providing a demonstration with regard to its duration is non-zero, i.e.,  $C_2 > 0$  (cost structures 2 and 5 of Table 1), then competition *decreases* the duration of each demonstration (proof is presented in Appendix A).**

We now address the issue of the *number* of demonstrations. With respect to the number of demonstrations, the first-order condition for the single firm in a monopolistic situation is:

$$\frac{\partial \pi^m}{\partial n_1} = -(1-h)(P_0 + wT) + (P_0 + w(T-t))K_1(1 - he^{-rt_1}) - 2C_1n_1 - C_2t = 0$$

The optimal number of demonstrations increases with the same factors that increase the duration of each demonstration, i.e., the software price  $P_0$ , full information purchasing probability  $K$ , the anticipated life cycle of the product  $T$ , and  $h$ .

Demonstration numbers decrease with the optimal duration of each demonstration. The first-order condition for the single firm in a duopolistic market

structure is:

$$\frac{\partial \pi^D}{\partial n_1} = \left( -\frac{1}{N} - \frac{n_2}{N^2} \right) N(1-h)(P_0 + wT) + (P_0 + w(T-t))K_1(1 - he^{-rt_1})V - 2C_1n_1 - C_2t = 0$$

$$\text{Where } V = \left[ \left( 1 - \frac{n_2}{N} \right) + \frac{n_2}{N} (1 - K_2(1 - he^{-rt_2})) \right].$$

### ***Proposition 2***

**If the variable cost of providing a demonstration with regard to the number of demonstrations is non-zero, i.e.,  $C_1 > 0$  (cost structures 4 and 5 of Table 1), then competition *decreases* the number of demonstrations offered by the single firm (proof is presented in Appendix B).**

### ***Corollary 1***

**If the cost of reaching a potential prospect is linear, then the optimum is reached either when the firm demonstrates to the entire potential market, i.e.,  $n = N$ , or when it does not demonstrate at all.**

A special case of linearity exists when the only cost of providing a demonstration is income loss. All software products that can be downloaded from the Internet and that do not require training or online support belong to this category. Since it does cost the firm to provide a demonstration, and since the firm cannot control and monitor who will download the demo, it is obvious that  $N = n$ , i.e., the firm will offer demonstrations to its entire target market.

## The case of Internet demonstrations

Propositions 1 and 2 analyze the change of a demonstration's strategy when market structure changes from a monopoly to a duopoly, and when a firm's cost structure is either 2, 4, or 5. Changing the competitive environment from a monopolistic to a duopolistic market structure does not affect a demonstration's strategies when cost structure is 1.

The Internet market is characterized by multiple competitors, and thus the model needs to be adjusted. Say that there are  $Q$  firms who offer their products for free trial. Let  $g(Q, t_i)$  be the probability that a prospective consumer will choose to test the product of firm  $i$ . It is reasonable to assume that the effect of an increase in competition intensity on  $g(\cdot)$  will be negative and concave.

The effect of an increase in the duration of a demonstration may be positive and concave, but alternatively, duration increase may have no effect. These two alternative outcomes will be tested in the empirical part of this paper. The single-firm profit function is represented by:

$$\pi_i^C = [P_0 + w(T - t_i)]K_{1i}(1 - he^{-rt_i})g(Q, t_i, t_{Q-i})$$

The first-order condition with respect to demonstration duration  $t$  is:

$$f = -wK_1(1 - he^{-rt_1})g(Q, t) + (P_0 + w(T - t))K_1rhe^{-rt_1}g(Q, t) + (P_0 + w(T - t))K_1(1 - he^{-rt_1})g_t = 0$$

Recall that  $f_t = \frac{\partial g(Q, t_i, t_{Q-i})}{\partial t_i} \geq 0$

From Implicit Function Theorem, we know that  $f_t dt + f_Q dQ = 0$ .

Differentiating  $f$  with respect to the demonstration's duration and the intensity of competition yields:

$$f_t = -w \frac{rhe^{-rt}}{1-he^{-rt}} - [P_0 + w(T-t)]r^2 \frac{he^{-rt}}{1-he^{-rt}} - t \frac{g_t}{g} + [P_0 + w(T-t)] \frac{g_{tt}g - g_t g}{g^2} < 0$$

$$f_Q = [P_0 + w(T-t)] \frac{g_{tQ}g - g_Q g_t}{g^2}$$

The above properties yield the following proposition:

**Proposition 3:**

**An increase in the intensity of competition increases the duration of each demonstration if:**

1. The software is offered for sale and evaluation through the Internet, i.e.,  $C_1=C_2=0$ ,  $w>0$  (cost structure type 3 in Table 1).
2. Increasing the demonstration's duration has a positive effect on the probability that the brand will be chosen for evaluation (using the demonstration), and this effect decreases with competition, i.e.,  $g_t > 0, g_{tQ} < 0$

**An increase in the intensity of competition decreases the duration of each demonstration if:**

3. Increasing the demonstration's duration has no effect on the probability that the brand will be chosen for evaluation (using the demonstration), i.e.,  $g_t = 0$

## 6. Empirical Findings

Proposition 3 suggests that software distributors who choose to demonstrate and sell their products via the Internet will increase the duration of each demonstration if the change in duration affects the probability that the software will be chosen for evaluation. Alternatively, if the increase in duration does *not* increase the probability of inclusion in

the choice set, then an increase in competition will decrease the duration of each demonstration

**Hypothesis 1:** In the Internet software industry, if an increase in the demonstration's duration does not affect the probability of inclusion in the choice set, then an increase in competition will decrease the average duration of each demonstration.

**Hypothesis 2:** If increasing a demonstration's duration increases the probability of inclusion in the choice set, then an increase in competition will increase the average duration of each demonstration.

If the only cost of providing a demonstration is the income loss, then the length of the demonstration is determined by competition, the effect of duration on the probability of evaluation, and the income loss. Income loss is a factor of the software price and its attractiveness. Attractiveness can be measured by software newness, i.e., old software is less attractive than new software.

**Hypothesis 3:** If demonstration costs consist only of income loss, then low-priced and aging software products will be offered for longer demonstration duration than high-priced and new software products.

Proposition 2 indicates that if the demonstration cost is affected by the number of demonstrations offered, then the firm will reduce the number of demonstrations offered with the increase in competition. Thus we assume the following hypothesis:

**Hypothesis 4:** When the cost of providing a demonstration is a function of the number of demonstrations, then the number of demonstrations decreases as competition intensity increases.

In order to test hypotheses 1-3, we collected data about software products offered

for demonstration in two popular sites: Tucows and Softseek. We downloaded all software products which were presented in these two sites during the last week of June, 1999, and used the data about the software category, the first available date of sale, price (available only for Tucows), and the duration of each demonstration.

We calculated the number of competitors by counting the number of software products offered for demonstration in each software category. Since software products which are not offered for demonstration do not appear in this sample, then our sample is an underestimation of competition intensity. However, it is unreasonable to assume that the number of firms who do not demonstrate are concentrated in a particular category, and thus measuring differences in competition intensity between categories seems appropriate.

Since Tucows' site policy is to provide a stage for demonstration and sale only for software manufacturers who offer their products for free evaluation for a period longer than a week, the sample is not representative, and thus we have chosen to use data from the Softseek site. However, the Softseek site does not provide details about the price of the product, and thus we measured its attractiveness by the age of the software. Tucows' data will be used later on to measure the effect of price on a demonstration's duration.

The effect of competition is measured with and without the effect of the software's age on the duration of a demonstration across all product categories. Formally we estimate the following two alternative equations:

$$1. \text{ duration} = a + b_1 \text{comp} + \varepsilon$$

$$2. \text{ duration} = a + b_1 \text{comp} + b_2 \text{age} + \varepsilon$$

Results are presented in Table 2.

**Table 2: The effect of competition and software attractiveness on the duration of a product demonstration**

	Without Attractiveness Effect	With Attractiveness Effect
Intercept	29.880 (1.166)	27.735 (1.583)
Comp	-0.009 (0.004)	-0.008 (0.004)
Attractiveness (Age)		0.007 (0.004)

Numbers in parentheses are the standard deviation. Adjusted R square (with): 0.011, R square without = 0.022 Regression F: 4.23 (P=0.041), and F=4.117 (P=0.017 respectively and the number of observations: 284

The low R Square and the high significance of the intercept indicates that most of the variance is captured by variables other than competition and price. However, the effect of competition and age is significant and in the right sign. The intercept may be viewed as the industry standard. Competition and attractiveness causes the software manufacturer to deviate from the industry standard. Including the attractiveness measure, age in the regression hardly changed the effect of competition, but reduced the industry standard (constant) from 30 to 27.

It is reasonable to assume that response to competition will vary across industries. For companies whose every day of free usage sharply decreases either income or purchasing probability, the effect of competition on demonstration duration will be negative and more dramatic than for companies whose income effect is relatively small. Since computer games have a short life span relative to other software, then it is

assumed that the average duration of a game's demonstration will be shorter than that of other software products. In addition, it is expected that in the game industry, competition will decrease the average duration more than in other industries.

The combination of short life and long demonstrations increases the probability that the prospective consumer will extract most of the game's benefit during the demonstration period, and thus will lose interest in purchasing it. In the computer game industry, there are two different strategies which aim to solve this problem.

Manufacturers can offer a restricted trial version or a full trial version limited in its duration. The operating restricting solution is designed in such a way that the consumer will get the flavor of the game but will not be able to fully use it. Restriction may apply to saving facilities, the number of levels that the player can pass, and the weapons that can be used.

If a restricted version is offered, then the question of duration is no longer relevant, and the relevant question is to find the balance between extraction reduction and the consumer's frustration. In this paper, we focus in duration and leave restriction for future research. Formally the following model had been estimated:

$$Duration = a + b_1\delta + b_2comp + b_3\delta comp + \varepsilon$$

$$\delta = \begin{cases} 1 = if\ Games \\ 0 = other \end{cases}$$

Coefficient estimation is presented in Table 3.

**Table 3: The effect of competition on the duration of Internet software products by industry**

	Coefficients	T value	P value
Intercept	31.15	23.057	0.00
Games	-5.662	2.071	0.039
Comp	-0.01	1.955	0.051
Games*Comp	0.007	0.753	0.753

The sample consists of 284 observations taken from Softseek data, and the R square is 0.024. The average demonstration duration of software in the professional market (education, programming, etc.) is 31.15 days, and for a game the duration falls to 25.488. Competition decreases the average duration by 0.01 days per competitor. However, the effect of competition on the duration of each demonstration is not significantly different for the game industry.

Hypothesis 4 suggests that if the only variable cost of providing a demonstration is income loss, then the higher the income loss, the shorter the length of the demonstration. Since, the Tucows data does not include companies that offer their software products for a period shorter than a week, it may affect the significance of competition. The comparative static of Proposition 3 suggests that price effect will be concave, and thus we estimated the following relationship:

$$\text{LAN}(\text{duration}) = a + b_1 \text{LAN}(\text{comp}) + b_2 \text{LAN}(\text{Price}) + \varepsilon$$

where LAN= natural logarithm.

Table 4 presents the results of this estimation.

**Table 4: The effect of software price and competition intensity on demonstration duration**

	Coefficient	STD Error
Intercept	3.345	0.159
LAN(Comp)	0.053	0.037
LAN(PRICE)	-0.049	0.03

Figures in bold are significant at 10% level. R square is 0.012. Competition does not significantly affect the demonstration duration. Changing the functional form from natural logarithm to number did not change the insignificance of the competition, but did change its sign. The negative sign of the price supports our theory, and thus if income loss is the only demonstration cost, then the higher the price, the shorter the demonstration's duration.

Another way to analyze the effect of price is to compare average prices and demonstration duration between the following three software categories: freeware, shareware, and demo. Since freeware is software products which are distributed freely, then income loss is not relevant. However, as the price of a shareware product is supposed to be lower than the price of products in other categories, then it may be useful to analyze price and duration in these software groups.

Four software products were unclassified and received the classification of "commercial". 25 were classified as demos, and 188 as shareware. Table 5 presents the average prices and duration of demonstrations offered across different software classifications.

**Table 5: Average prices and durations of commercial, demo, and shareware products**

Software Type	Average Price	Average Duration	Number of firms	t-test Price	t-test Duration
Commercial	294.1 (237.948)	22 (9.238)	4		
Demos	162.467 (164.419)	25.12 (9.576)	25	1.066	0.6247
Shareware	66.550 (85.735)	31.163 (18.035)	188	2.866	2.605

Figures in parentheses are standard deviation

Table 5 illustrates that the length of the evaluation period is negatively related to the price of the software.

Hypothesis 4 suggests that if the cost of providing a demonstration is a function of the number of demonstrations, then the number of demonstrations decreases as competition intensity increases. In order to validate Hypothesis 4, we collected data on the number of demonstrations, the number of competitors, and the relative strength in 3D industrial software, a truly global village product. The same product is sold worldwide with four different screens and documentation languages: English, French, German, and Spanish.

We collected data reflecting the marketing operations of Graphitec, a leading industrial 3D software manufacturer. Graphitec's main branches are located in Los Angeles, Tokyo, Tel Aviv, and Munich, and it sells its software in 17 countries around the world. Graphitec software allows the manufacturer to scan the selected design, make the desired changes, and automatically program the manufacturing machines, all in 3D technology. Graphitec has been active in the global market since 1994, and has four competitors: French, British, Canadian, and a former Israeli company that now operates

in the US (New York).

In this industrial market, the product must be demonstrated personally to the prospective client before it can be considered a viable alternative. The demonstration process starts with a salesperson or system engineer who performs the product demonstration and continues with customer training. The product is then left with the customer for a trial period of 3-6 weeks.

Since this product does not physically deteriorate in the six-week time period, this demonstration arrangement closely approximates Type 4 cost structure (see Table 1), i.e., the firm has no expenses relating to the length of demonstration, but it does have an expense as a function of the number of demonstrations offered.

We collected data reflecting the demonstration operation of Graphitec, and the number of competitors in each market during 1994-1997. This data is presented in Table 2. Table 2 presents the number of demonstrations and the number of competitors in each country during those four years. We have data on 23 countries, 19 with multiyear records and four new (1997) entities, bringing the number of cases to 66.

We employed standard linear regression to measure the relationship between the change in the number of demonstrations as a function of the number of competitors, and a dummy variable which represents the country. The country variable represents both the differences between countries in attitudes toward the various competitors, and the strength of the country's distribution system. Formally our econometric model is:

$$Demo_{jt} = \alpha + \beta_1 Comp_{jt} + \beta_2 * j + \epsilon$$

$Demo_{jt}$  represents the number of demonstrations offered at each period  $t$  in country  $j$ .  $Comp_{jt}$  represents the number of competitors at time  $t$  in country  $j$ , and  $j$

represents country j. The results of the above estimation are presented in Table 6.

**Table 6**

<b>Variable</b>	<b>Value</b>	<b>P</b>
<b>Constant (<math>\alpha</math>)</b>	18.3	
<b>Competition (<math>\beta_1</math>)</b>	- 3.657	0.024
<b>Country (<math>\beta_2</math>)</b>	(relative to the USA)	0.000
<b>Brazil</b>	-9.815	
<b>Canada</b>	-3.002	
<b>China</b>	-3.408	
<b>France</b>	-7.206	
<b>Germany</b>	26.155	
<b>Hong Kong</b>	-9.081	
<b>Italy</b>	16.599	
<b>Korea</b>	-0.830	
<b>Mexico</b>	-8.987	
<b>Netherlands</b>	-4.664	
<b>Russia</b>	2.834	
<b>Singapore</b>	-5.872	
<b>Spain</b>	-10.565	
<b>Sweden</b>	-3.330	
<b>Taiwan</b>	-3.494	
<b>Thailand</b>	-2.158	
<b>Turkey</b>	-8.987	
<b>UK</b>	-9.987	

Adjusted R square = 0.888.

The country coefficients are relative to the US, their significance lying in their indicating that each county has its own characteristics. However, the effect of competition is significant and supports our hypothesis that competition decreases the number of demonstrations offered.

## 7. Conclusion

Our main findings are that the decision about demonstrations' duration is made regardless of the decision regarding their quantity. This means that the firm first determines the duration of each demonstration, and then, based on this decision,

determines the number of demonstrations to be offered. The number of demonstrations is a negative function of their duration.

The duration of a single demonstration increases with the average probability of the product's fitting the customer's needs, the price of the product, increases in the firm's recognition among consumers, word-of-mouth information, speed of learning, cost of demonstration, and the depreciation of the product's benefits over time. When the competition factor enters, then the duration of each demonstration decreases as a function of the competitors' strength and their demonstration efforts.

If the cost structure is of Type 2, 4, or 5, i.e., a demonstration's cost is a function of either the quantity or the duration of demonstrations, then competition decreases both the number of demonstrations and the duration of each single demonstration. If the cost of providing a demonstration is a function of income loss (such as all demonstrations made available via the Internet), then competition may increase or decrease the duration of each demonstration, depending on the effect of duration on the probability of the product's inclusion in the evaluation set.

We partially support empirically our theoretical findings using data from two industry sectors: one that uses the Internet for software sales and distribution, and the industrial software market. The analysis of the Internet software industry data shows that competition had a negative effect on the duration of the average demonstration regardless of the sub-industry. Game software products are offered for shorter durations than programming or other professional software products. This significantly shorter duration can be explained by the relatively short life of a game. A combination of short life and long demonstration proves deadly for sales, and thus it is avoided.

We also show that the demonstration's duration is inversely related to the product's price, and positively related to its aging. We did not find support for our hypothesis that duration may contribute to the probability that a software product will be included in the evaluation set, and thus we may say that consumers' choice of the evaluation set is probably a function of advertising and recommendation rather than demonstration duration.

We provided empirical support for the Type 4 company's cost structure where we showed an inverse relationship between the demonstration level and the intensity of competition in the graphics software industry. The empirical part suffers from many shortcomings: first, the data reflects businesses in 23 countries, whose markets most likely differ widely. Also, we captured the aggregate difference by estimating a "country" variable. It would be of interest to measure reactions to competition within the same market.

One limitation of this paper is that price of the product was not considered an element in the consumer's decision, i.e., we assumed that consumer choice is based only on the degree of fit to her needs. This assumption is realistic in markets where the price difference between brands is not an issue—which is the case with many products—and may be less realistic if price is important.

We partially analyzed the effect of price in our comparative static analysis. Another restrictive assumption regards the role of the consumer in determining the duration of a demonstration. While the consumer has no significant influence in mass markets such as those of most of the software offered for sale in the Softseek and Tucows sites, it may be otherwise in small markets such as that of statistical software packages. When the market is small and the software is expensive, consumers may

demand longer demonstrations than the firm wishes to offer. However, the effect of competition is not supposed to change.

We did not model two important industries. First, the freeware market, and second, the restricted version of conventional software. While freeware can be viewed as a demonstration with no time limit it, can also be viewed as a two-stage selling tool. First, you convert the customer and increase her future switching costs, and then you offer a better-featured model. The restricted version is used in order to avoid the scenario wherein the consumer extracts most of the benefit of the software during the demonstration period, but it has its costs, as it may frustrate the customer and reduce the purchasing probability. Analysis of these two markets would seem to constitute a promising future research area.

In addition, one might wish to model consumers' choice behaviors, in particular the role of demonstration as a signal.

Finally, from a managerial point of view, we provide a better understanding of the normative behavior of the firm, offering simple rules: If duration does not increase the probability of inclusion in the evaluation set, then the best reaction to competition is to reduce both the duration and the number of the demonstrations.

On the other hand, if the cost structure is Type 1, i.e., it has a fixed cost element only, then the firm should offer demonstrations to every consumer without considering the intensity of competition. If duration helps the firm to be elected for further in-depth evaluation, then the firm should increase its demonstration efforts as a result of competitive pressure.

## **References**

- Freedman, J.L. and Fraser, S.C. (1966), "Compliance Without Pressure: The Foot in the Door Technique", *Journal of Personality and Social Psychology*, 18, 195-202.
- Grossman, G. and Shapiro, C. (1984), "Informative Advertising with Differentiated Products", *Review of Economic Studies*, 51, 63-82.
- Heiman, Amir and Muller, Eitan (1996), "Using Demonstration in New Product Diffusion: The Theory of Demonstration Duration", *Journal of Marketing Research*, 33, 422-430.
- Heiman, McWilliams, and Zilberman (1999), "Demonstrations and Money-Back Guarantees: Market Mechanisms to Reduce Uncertainty", *Journal of Business Research*, forthcoming.
- Dipak, Jain, Mahajan, Vijay, and Muller, Eitan (1995), "An Approach for Determining Optimal Product Sampling for the Diffusion of New Products", *Journal of Innovation Management*, 12, 124-135.
- Johnson, Eric and Russo, J. Edward (1984), "Product Familiarity and Learning New Information", *Journal of Consumer Research*, 11, 542-550
- Johnston, Stuart J. (1994), "PC Pricing Reconsidered: Free NT Test Drive Debuts", *Computerworld* v28, n41 (Oct 10, 1994): 1,149.
- Lutz, Richard (1986), "Quality is as Quality Does: An Attitudinal Perspective On Consumer Quality Judgment", presentation to the Marketing Science Trustee's Meeting, Cambridge MA, USA
- Mahajan, Vijay, Vithala, R. Rao, and Srivastava, Rejendera K. (1994), "An Approach to Assess the Importance of Brand Equity in Acquisition Decisions", *Journal of Innovation Management*, 11, 221-235.
- McWilliams, Bruce and Zilberman, David (1996), "Time of Technology Adoption and Learning By Using", *Economic Innovation and New Technology*, 4, 139-154.
- Pliner, P., Hart, H., Kohl, J., and Saari, D. (1974), "Compliance Without Pressure: Some Further Data on the Foot in The Door Technique", *Journal of Experimental Social Psychology*, 10, 17-22.
- Ratneshwar, S. L., Warlop, David, Mick, Glen, and Seeger, Gail (1997), "Benefit Salience and Consumers' Selective Attention to Product Features", *International Journal of Research in Marketing*, 14, 245-259.
- Scott, Carol A. (1976), "The Effects of Trial and Incentives on Repeat Purchase

- Behavior”, *Journal of Marketing Research*, 13, 263 - 269.
- Slofstra, Martin. “Cabletron Issues Challenge to its Network Competitors”, *Computing Canada*, v21, n17 (Aug 16,, 1995): 37-38.
- Steenkamp, Jan-Benedict E.M. (1990), “Conceptual Model of Quality Perception Process”, *Journal of Business Research*, 21, 309-333.
- Sujan, Mita (1985), “Consumer Knowledge: Effects on Evaluation Strategies Mediating Consumers’ Judgments”, *Journal of Consumer Research*, 12, 16-31.
- Weiber, R., and Adler, J. (1995), “A Classification of Purchase Processes Based on Information Economics,” *Zeitschrift Fur Betriebswirtschaftliche Forschung*, 47, 1, 43-65.

## Appendix A

Proof of proposition 1:

$$\text{Let } V = \left[ \left( 1 - \frac{n_2}{N} \right) + \frac{n_2}{N} (1 - K_2 (1 - h e^{-r_2})) \right].$$

Rearranging  $\frac{\partial \pi^D}{\partial n_1}$  and assigning V yields the implicit solution for the duration of a

demonstration offered in a duopolistic market situation.

$\left[ -wK_1(1 - h e^{-r_1}) + (P_0 + w(T - t))K_1 r h e^{-r_1} \right] V = C_2$ . This solution is identical to the one obtained in the monopolistic market structure, except for V, which is smaller than 1, and thus  $\left[ -wK_1(1 - h e^{-r_1}) + (P_0 + w(T - t))K_1 r h e^{-r_1} \right]$  must increase. Since it decreases with t, the single firm in the duopolistic market structure must decrease the duration of each demonstration relative to the monopolistic market structure.

## Appendix B

The optimal number of demonstrations in the monopolistic market is

$$n_1^m = \frac{-(1-h)(P_0 + wT) + (P_0 + w(T - t^m))K_1(1 - he^{-rt_1^m}) - C_2 t^m}{2C_1}$$

The optimal number of demonstrations in the duopolistic market is

$$n_1^D = \frac{-(1-h)(P_0 + wT) - \frac{n_2}{N}(1-h)(P_0 + wT) + (P_0 + w(T - t^D))K_1(1 - he^{-rt_1^D})V - C_2 t^D}{2C_1}$$

$$\text{Let } A(t) = (P_0 + w(T - t))K_1(1 - he^{-rt}) - C_2 t$$

Since  $t^m$  maximizes the profits of the monopolist, and this profit can be written as  $n_1 A(t) - C_1 n_1^2$ , then it follows that  $A(t^m) > A(t^D)$ . Since  $V < 1$ , it follows that

$$A(t^D) > (P_0 + w(T - t^D))K_1(1 - he^{-rt^D})V - C_2 t^D. \text{ Adding to the numerator of } n_1^D \text{ a}$$

negative argument decreases its value i.e.,

$$\begin{aligned} & -(1-h)(P_0 + wT) + (P_0 + w(T - t^D))K_1(1 - he^{-rt^D})V - C_2 t^D > \\ & -(1-h)(P_0 + wT) - \frac{n_2}{N}(1-h)(P_0 + wT) + (P_0 + w(T - t^D))K_1(1 - he^{-rt^D})V - C_2 t^D \end{aligned}$$

This proves proposition 2.