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Defining and measuring the economic benefit of electronic article surveillance

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Abstract

This paper uses three actual case studies to define the quantifiable economic benefits which retailers derive from the use of Electronic Article Surveillance (EAS) equipment as an anti-shoplifting tool. The author describes the major analytical methods used to compare inventory shortage statistics, demonstrates how very large EAS users utilized the data in order to provide a basis for a return on investment calculation, and draws some conclusions on the effectiveness of EAS based upon over 30 statistical samples that have been taken over the past 15 years. In brief, the evidence suggests that EAS can achieve significant reductions in shoplifting and in total inventory shortage of the order of 35-75%.

Keywords: Electronic article surveillance (EAS); Inventory shortage; Retail Savings

1. Introduction

Electronic article surveillance (EAS) is the term used to describe retail anti-shoplifting protection systems for both apparel and packaged products. These systems have been successfully implemented in tens of thousands of stores worldwide. They were introduced in 1968-69, and have been in widespread use since the mid-1980s.

In essence, an electronically detectable element (tag) is either pinned onto a garment or affixed via adhesive to the item to be protected. Transmitters and receivers are placed at store exits in order to detect the presence of the tags as shoppers leave the stores. At the point of purchase, these tags are either removed or rendered inoperative (deactivated) so that the purchaser may exit the premises without setting off an alarm. If a shoplifter were to attempt to leave the store while carrying items which contained the 'live' electronic elements, the detection equipment at the exit would sound an alarm, and appropriate security counter measures could be taken.

These systems have proved to be an effective psychological and physical deterrent to shoplifting, and in recent years technological improvements have provided more reliable, smaller, and less expensive products. In concert with the social benefits of shopping in stores which are relatively free from crime, the use of EAS provides some very real and quantifiable economic benefits to the user retailer. The scope of this paper is to define these benefits; describe the major methods of statistical analysis; and demonstrate, via case studies, how very large EAS users use the data in order to provide a basis for a return on investment calculation.

The primary benefit earned through the use of security systems like EAS is the reduction of inventory shortage (shortage), which is the money lost when a retailer compares the amount of merchandise which is physically present in the store at a given time to the amount of merchandise that the statement of accounts shows should be present. This calculation is routinely made on a semi-annual basis in order to include shortage as a component of gross margin and, eventually, profit and loss. Accurate inventory reconciliation statistics are readily available, though proprietary to each retailer. Most of the larger American retailers assign inventory reconciliation duties to a specific group of accounting personnel. These statistics, as with most retail data, are generally reported in dollars and as a percentage of sales.

Over the years, the power of the economic argu-

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ments for EAS has dominated the decision process. While there exists an abundance of internal data prepared by retailers and EAS manufacturers which proves the economic effectiveness of EAS, almost none of it has been published. One small study on the effects of the psychological deterrence of EAS systems was conducted at the University of Wisconsin-Whitewater (Scherdin, 1986). This attempted to quantify whether there was a significant difference in the rate of book theft before and after installation of an electronic security system, and concluded that theft levels were reduced for both books, which were protected by EAS, and audiovisual materials, which were not protected by EAS [1].

2. A brief history of the development of the measurement techniques

In the 1970s, retailers used EAS as a means to apprehend shoplifters. As more and more large chains began to install EAS systems, the focus changed to deterrence rather than apprehension. Retailers began to recognize that it was more beneficial to stop shoplifters from attempting to steal, and they began to employ EAS more fully and completely. Concurrently, EAS technology began to become much more user friendly, specifically by becoming smaller and less expensive.

At that time, it was relatively simple for a retailer to cost justify an EAS expenditure. The systems were installed in stores which generated the highest inventory shortages. The products deterred shoplifters, and shortage levels began to fall rapidly, so a strictly constructed financial analysis was not required. Beginning in 1982-83, however, as economic conditions became more competitive, as inventory shortage became somewhat more manageable, and as store operating expenses started to rise, retailers began openly to question the investment in EAS equipment. While knowing intuitively that the product was working because sales associates were finding less evidence of theft, retailers began to demand a hard and fast cost justification. Since the dynamics of this process were not well understood, the initial response from EAS vendors was to discount the cost of the equipment, which by definition would improve the cost justification, instead of trying to demonstrate some sort of economic benefit — such as measuring the depth and breadth of the reduction in shortage.

Additionally, the complexity of retail inventory shortage became a factor in choosing EAS as a security solution. While there may be only three generally accepted causes of inventory shortage-shoplifting, internal theft, and poor transaction control, it is nearly impossible to establish a proportion for each. Each retail environment has its own dynamics. One store might have exceedingly poor document control, while the adjacent store has more dishonest employees. Though retail accounting rules may be somewhat standardized under generally accepted accounting principles, there is wide latitude in the application of those standards. Consequently, it became almost impossible for EAS vendors to prove that reductions in inventory shortage were a function of a successful EAS program. In some cases, EAS was unfairly blamed for rises in shortage!

Around 1983, Sensormatic Electronics Corporation (the world's largest EAS manufacturer) made a significant investment in a program which helped its clients actually measure the performance of EAS products. At that time, my role at Sensormatic was that of a national account sales manager with responsibility for large West Coast clients. Because of my retail, financial, and security industry background, I was given the responsibility to design and build this program from inception in an effort to stimulate sales and to understand better the customer base.

During the mid to late 1980s more than 30 statistical studies were conducted using actual inventory reconciliation data. Access was given to the inventory reconciliation data in order to assist store management in gaining an understanding of the dynamics of inventory shortage. All of this work was undertaken with the full co-operation of, and for the sole benefit of the retail chains which participated. Today, cost/benefit analyses of this type are routinely performed by Loss Prevention, Internal Audit, Shortage Control, or other retail financial executives. Enlightened EAS salespeople are also conversant with the techniques employed.

On the strength of these studies, some very strong conclusions can be drawn regarding EAS as a profit producer in the retail environment. The primary conclusion is that the use of EAS equipment can successfully reduce shoplifting and total inventory shortage anywhere from 35 to 75%, depending upon the type of retail environment and the thoroughness of the system's usage. This reduction translates into increased profitability — all other factors being equal. Second, EAS equipment can be cost justified using traditional methods of financial analysis, such as comparing economic costs to benefits. Third, preserving the heart of a merchandise assortment by preventing theft can improve sales, and this improvement can be measured.

The three brief case studies which follow illustrate methods used to collect and examine data in order to analyze the three following questions:

- Will EAS reduce inventory shortage, and if so, by how much?
- What is the effect on shortage if EAS is removed and subsequently re-installed?

- How can the effects of EAS be measured if the equipment is installed in different locations over a period of years?

3. Will EAS reduce inventory shortage, and if so, by how much?

This is the single most important question, and it can be answered precisely and with the certainty of over 15 years of experience with the shortage statistic analysis. In this first case, the client was a large department store chain with 16 locations, which was an operating division of a nationally prominent holding company with over 200 locations. The operating division had introduced EAS in eight stores, and was attempting to quantify its results in order to decide whether to expand EAS into the rest of the chain.

The use of EAS is determined generally by two factors. Of primary concern is the level of inventory shortage which has been incurred. Typically, the retailer chooses to use EAS on items with high shortages because an appropriate return on investment can be achieved. Of secondary concern is whether or not there exists an appropriate EAS product to protect the desired merchandise category. In the late 1960s and early 1970s, apparel was virtually the only type of merchandise which could be protected. As time passed, EAS companies designed adhesive label-like products which could be affixed to packaged products, thereby opening up many more merchandise categories to adequate protection. As of today, several high shortage merchandise categories remain inadequately protected by EAS. The most common example is fashion jewellry, where most rings, watches, and necklaces are locked in security fixturing rather than protected by EAS.

The information provided in this case demonstrates a critical idea regarding EAS performance measurement. The gauge of the success or failure of the EAS program should be a function of shortage results in those departments which use the system, and not necessarily a function of total store (overall) shortage. Management procured EAS in order to curb shoplifting in approximately 40 men's and women's apparel departments, where inventory shortages exceeded 3.5% of sales, and represented about 60% of the chain's sales volume and over 70% of its shortage. Shortage in other departments, like children's, shoes, housewares, and others, was not considered a problem and was not singled out for EAS use. In fact, shortage in these other areas did not exceed 2% of sales. When combining the statistics to examine the overall shortage in a department store, they masked the serious situation in the apparel departments. Senior management tended to take a macro viewpoint and focused upon the overall shortage which was equal to or below the industry average. A detailed micro analysis was required in order to fund any additional anti-shoplifting programs.

The primary goal of the analysis was to isolate the inventory shortage statistics so that EAS user stores could be compared to non-user stores, and EAS user departments could be compared to non-user departments. Additionally, statistics were developed which compared the shortages before and after the use of EAS. When the analysis was completed, management could examine the statistics from the apparel departments in the eight EAS user stores in order to determine: (1) whether shortage correlated with the same data from the eight non-EAS stores; (2) whether shortages dropped during the time period where EAS was introduced; (3) whether the same statistical tendencies were exhibited in the merchandise departments which did not utilize EAS; and (4) whether there was any correlation to overall shortage statistics (see Fig. 1).

The graph in Fig. 1 demonstrates some key points. First, shortage in the apparel departments (EAS users) dropped steadily since year 1, while shortage in the apparel departments in the eight non-user stores rose during the same time period. Second, overall shortage in the user locations dropped at a slower rate than in the user departments — indicating that shortages rose in other departments within the same locations. In these cases user departments represent about 60% of the stores' total sales, so the entire overall shortage reduction was attributable to the performance in the EAS tagged departments. Third, overall shortage in the eight non-EAS stores rose steadily, while falling in the EAS user stores. Performance of this nature was common, and is characteristic of retail chains which stagger installation of EAS over a period of years. This topic is to be covered below in the third case study.

In summary, shortage in EAS user departments in user stores decreased about 17% during the 5 years of the study. Shortage in the same departments in the non-EAS user locations rose 30% during the same time. Overall shortages decreased in EAS user stores strictly on the strength of the shortage improvement in the user departments.

The introduction of EAS was the only security measure that was introduced selectively in this department store chain. All other security programs were evenly applied across all stores. Because of the accuracy and thoroughness of the study, management drew two conclusions. First, the results in the EAS user departments and stores were clearly superior to results in non-EAS locations, and second, that EAS would be introduced into all remaining stores. As of this writing, the chain continues to use EAS in all stores.

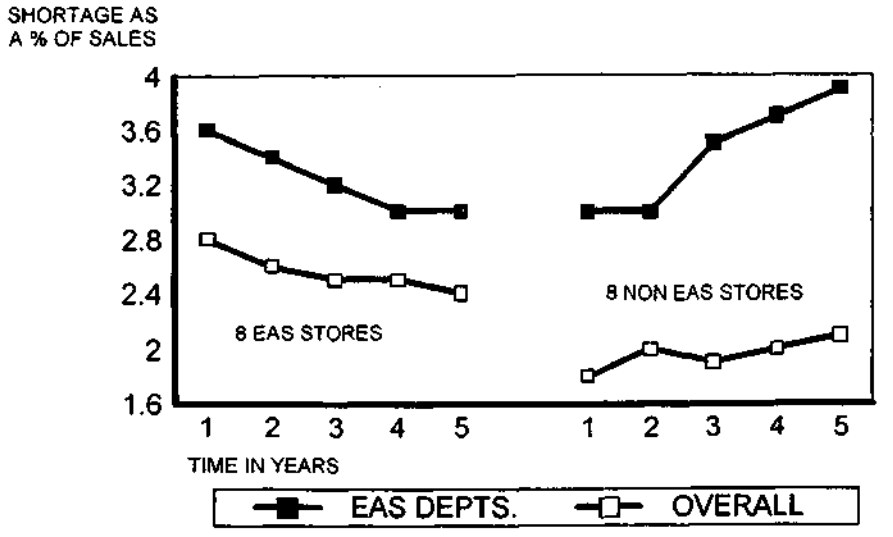

Fig. 1. Shortage comparison betweeen stores with and without EAS.

4. What is the effect on shortage if EAS is removed, then re-installed?

This next case describes a 9-year experiment with EAS in a prominent West Coast department store division of a nationally recognized chain (not the same as in the case mentioned above). In the late 1970s, EAS was installed in seven of 12 stores with great success. Before the equipment was installed, the EAS user locations incurred overall shortages of about 4.0% as a group. These stores were in predominantly urban locations. The fashion apparel departments were the designated EAS user departments. Before installation, the aggregate shortage of this group exceeded 7.0% of sales. During the first year after the installation, shortage in the EAS user departments dropped 47%, and the shortage in these departments in one particular store (store 360) dropped over 80%.

Management was pleased with the decision to install EAS, but because store 360's shortage dropped precipitously (to about 1.4% of sales), they decided to remove the EAS equipment and place it in another location with high shortage. It was thought too costly to maintain the EAS system in a store with such a low shortage, and doubted that shortage levels could possibly return to the previous high. In order to add some deterrent qualities to this situation, it was agreed to leave the electronic detection equipment positioned in the store's exits, but to remove all plastic tags and accessory devices.

The EAS equipment was removed in early 1980. Immediately after its removal, shortage began to rise quickly. Between 1980 and 1982, shortage in the EAS user departments rose from 1.4% of sales to 7.7%. Based upon the disastrous 1982 results, management decided to reinstall EAS.

The information contained in Fig. 2 demonstrates another key point regarding the use of shortage statistics to establish an economic benefit for EAS systems. The removal of the EAS equipment resulted in a large and immediate rise in inventory shortage. The subsequent re-installation of the equipment resulted in another dramatic shortage reduction. This data provides some statistical verification of the value of the system. Additionally, many of the same patterns of shortage performance chronicled in the first case study have been repeated in this case. Most notable is the idea that shortages in user stores can sustain a gradual reduction over an extended time, while shortages in non-user stores tend to rise during the same period.

As in the first case, comparing shortage results before and after the installation of EAS equipment demonstrates the pivotal economic benefit to the retailer. To illustrate the point, in the last year before the re-installation of EAS, store 360's annual sales in the EAS user departments were approximately $8 million. A 7.7% loss equalled $616000. During the next year, after the re-installation of EAS, shortage dropped to 2.9% on sales of $8.2 million, or a loss of only about $238000. The difference of $378000 (reduced to its cost complement) is the pool of money which is used to cost justify the equipment purchase. The cost of re-outfitting the store and managing all aspects of the EAS system was only about $105000, thereby providing a highly beneficial return on the investment.

5. How can the effects of EAS be measured if the equipment is installed over a long period of time?

Most multi-store users of EAS equipment install it in groups of stores over time (usually years). Characteristically, EAS is first installed in stores with short-

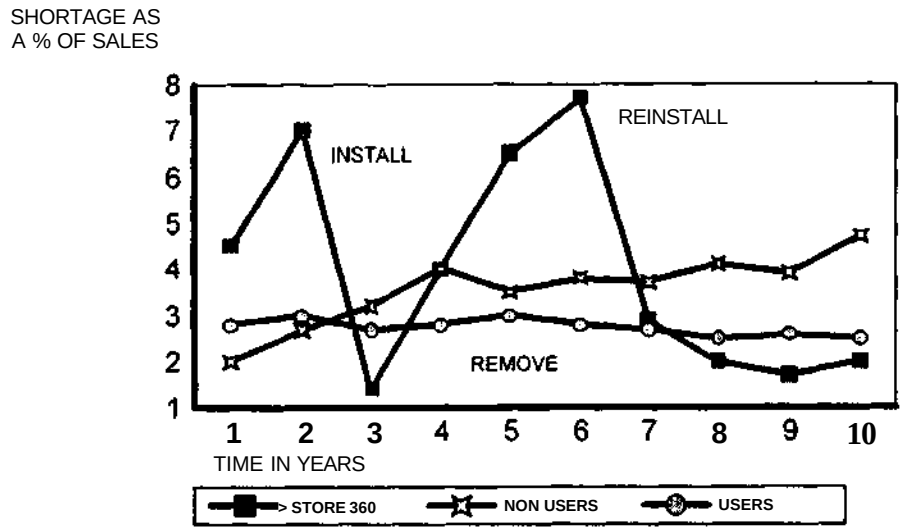

Fig. 2. Effects on shortage of removal and reinstallation of EAS in one store (No. 360) compared with other user and non-user stores.

ages at crisis levels. As shortages drop in the initial installations, other stores become candidates and the process repeats itself until either all stores become users or the economic situation in the remaining stores does not warrant EAS.

The following third case is taken from a large East Coast department store division of a nationally prominent chain. Over a period of 9 years, the division installed EAS in six different groups of stores until about 45% of the stores were equipped (21 of 46 stores). Each group contained between two and five locations. The EAS-user stores represented about 62% of the division's sales volume. Senior management was accustomed to reviewing overall shortage data on a chainwide basis, and since these figures remained fairly constant, they questioned whether EAS had any positive economic impact.

In reviewing the shortage data, it became clear that the piecemeal installation of EAS had little impact upon chainwide overall shortage for two reasons. First, the shortage and sales in each group of EAS user stores represented only a small fraction of chainwide shortage. Since these groups were installed over a long period of time, the net effect of any shortage improvement was hidden by the magnitude of the chainwide numbers, and by the fact that the reductions took place over such a long time period. Second, inventory shortages were rising chainwide in the apparel portion of the business, the departments in which EAS was installed, while shortage performance in hardlines was improving. The net result was that overall shortages were unchanged even though each user store had shown dramatic improvement in its apparel shortage.

In order to clarify the situation, the same statistical techniques described in the first two cases were applied here. Statistics from EAS user and non-user stores and departments were isolated and the installation dates for EAS were obtained. Individual store statistics were accumulated and analyzed, but due to the staggered installations, no clear picture existed of the size or rate of impact that EAS may have had on the profitability of the company. In order to solve this problem, a *shortage performance matrix* (DiLonardo, 1985) was designed which provided a method with which to align the statistics regardless of the year of installation [2]. Starting with the pre-installation base year, the matrix measures shortage performance in stores as if EAS had been installed simultaneously in all of them. For example, assume that three stores installed EAS in 1982, four stores installed in 1983 and five stores installed in 1984. The base year for statistical purposes is the last full year of shortage data before the EAS installation. As in the other cases mentioned above, this is when high shortages force management into making decisions. In our example, 1981 is the base year for the stores which had EAS installed in 1982; 1982 is the base year for stores installing EAS in 1983, and so on.

Fig. 3 illustrates this idea graphically. The X-axis is the time function which plots the base year, the year EAS was installed, and the subsequent four years — providing a composite performance over an extended period of time. Since all data begins with a base year instead of a chronological year, groups of stores installed at different times can be treated statistically as a unit. This method can be employed to study overall shortage or shortage within merchandise categories. An analysis of this type is not complex because inventory shortage is reported in dollars and as a percentage of sales. Therefore, the shortage percentage for the composite base year is simply the accumulation of the shortage dollars divided by sales dollars in the same departments or stores.

In Fig. 3 shortage in EAS user stores dropped from 4.5% to 2.75% in the first full year after the installation, a reduction of about 39%. Shortage continued to drop for the next 4 full fiscal years. For the non-user stores, shortage rose about 13% over the 6-year period which was during a similar time as the user stores. It is interesting to note that the shortage performance of the entire chain barely changed. Inventory shortages dropped significantly in the apparel departments of the EAS user stores, while rising in non-user stores. The matrix helped to quantify the aggregate amount of the savings, and the results supported a decision to install EAS in the remainder of the stores.

6. The relationship between shortage and sales

It is worth noting that the amount of inventory loss has a direct and measurable impact upon a store's sales. If an item is stolen from a store, the opportunity to sell it for a profit is lost forever. Additionally, all of the costs incurred to bring that item to market are lost. If enough items are stolen rather than sold, the retailer suffers because of an increase in shortage and because he has less items left to sell. To illustrate, assume that a fruit stand contains ten apples which are to be sold for $1.00 each. If all are sold, the retailer realizes $10 in sales and zero in shortage. If two are stolen and eight are sold, sales drop to $8, and inventory shortage rises to $2, or 25% of sales. The costs associated with bringing all ten apples to market are the same in both cases. Over time, the combined losses can have disastrous effects on the profitability of the store.

As has been shown in the above cases, the typical EAS user installs equipment in high volume, high shortage stores because the financial payback from shortage reduction is earned fastest. Additional stores are protected as shortage rises to crisis levels. Some enlightened retail chains install EAS equipment in all new stores as each is opened as 'insurance' against high shortage. Historically, however, the primary reason for the application of EAS has been to stimulate a reversal in deteriorating shortage results.

A look at the merchandise assortment planning process provides a more positive view of EAS as a management tool. Successful stores, whether a single or multiple unit operation, prepare and execute model stock plans based upon sales projections. They begin with a revenue forecast and work backwards to the number of units required to be sold at a given price in order to achieve the plan. In general, a high volume store receives a better selection and more depth of stock. A medium-sized store receives a slightly narrower selection, with some marginal styles excluded. A small store receives only the most marketable items even though it is generally accepted (Poisson theory of distribution) that small stores require a higher percentage of total stock in order to generate a smaller percentage of sales. Each style, size, and color in the small store's assortment is critical to sales performance. Even a small amount of shoplifting of key items will negatively impact a small store's merchandise assortment, and the net result is higher shortage and lower sales. Little work has been done in studying this aspect of the potential economic benefits of security devices like EAS.

7. Conclusions

Retail inventory reconciliation statistics clearly show that EAS has been, and continues to be, an effective

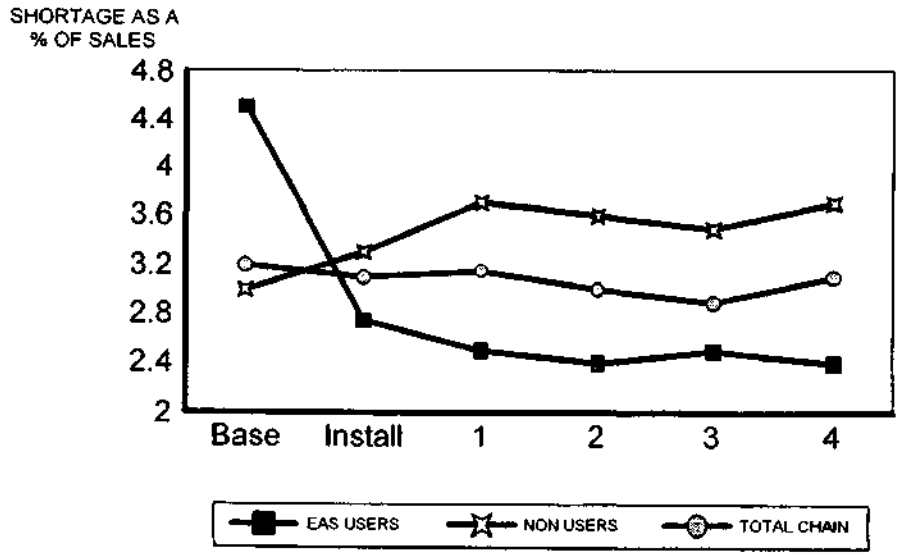

Fig. 3. Shortage comparison (using the shortage performance matrix) of EAS user stores (21) with non-user stores (25).

anti-shoplifting tool. Historically, almost all retailers have used the retail method of accounting, which records almost everything as a percentage of sales. The consistency of this method of reporting makes comparison studies between retail organizations relatively easy to accomplish. Until the mid to late 1980s, the industry had some difficulty isolating and reporting the relevant statistics, but since that time the methods explained in the cases above have become standard operating procedure for retailers around the world.

The most important methods of measurement are comparative in nature. Shortage in EAS user stores should be compared to non-user stores. As mentioned previously, overall shortage is not necessarily the best indicator of performance. Shortage statistics in the EAS user departments should be compared to those in non-user stores. Finally, the best yardstick for economic measurement compares the performance before EAS was installed to results afterwards.

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