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REDUCING COSTS OF  
STOCK TRANSACTIONS:  
A STUDY OF ALTERNATIVE  
TRADE COMPLETION SYSTEMS

Vol. I: Summary of Results

R. L. Petruschell, D. J. Dreyfuss, L. E. Knollmeyer and J. Y. Lu

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A Report prepared for  
AMERICAN STOCK EXCHANGE, NATIONAL  
ASSOCIATION OF SECURITIES DEALERS  
NEW YORK STOCK EXCHANGE

**Rand**  
SANTA MONICA, CA. 90406

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## FOREWORD

A large and unforeseen increase in trading volume late in 1968 and early in 1969 created serious problems for the securities industry. The flood of orders caused paperwork backlogs in broker-dealer operations and progressively higher levels of incomplete transactions. This gave rise to unprecedented numbers of customer complaints and drew critical attention from the exchanges, the National Association of Securities Dealers, the Securities and Exchange Commission, and from the Congress.

As a consequence, staff members from The Rand Corporation were asked to meet, in the beginning of 1969, with officials of the American Stock Exchange, the National Association of Securities Dealers, and the New York Stock Exchange to discuss industry problems and to explore the possibility of applying Rand research techniques to assist in identifying the most promising solutions to them.

It was decided that Rand would attempt to develop methods for analysis of these problems, including a simulation model to represent the functioning of the trade completion system. With a simulation model, it would be possible to test the performance implications of a wide range of policy and procedural alternatives without costly, actual experimentation. The trade completion part of stock trading activities was selected as the focus of attention because it is in that area that the great majority of operational problems originate.

The essential analytical methods have now been developed. These include use of a simulation model of the trade completion system and a related cost estimation procedure. They have been tested and applied and the results of a number of possible changes in trade completion processes are presented in the examples shown herein. As important as the results is the creation of the model that now permits the industry to examine critically the possible outcomes of many alternative ways of handling this significant part of its activities.

At the request of the Board of Governors of the National Association of Securities Dealers, special studies were made of the possible impact on trade completion of sales of mutual fund shares and new issues. On the basis of a preliminary examination of these two problems, they did not appear to present significant special burdens for the trade completion process and descriptions of these studies are not included in this report on Rand's work.

The report of the work undertaken is presented in three volumes and a supplement so that the special interests of various groups of readers may be better served. Volume I is a summary of the study and the results. Volume II describes the model in general terms, the cost methods, the alternatives examined, and the savings that could be realized under the various alternative system configurations. Volume III describes, in detail, the model, the computer program, and the data collected. A copy of the computer program is available as a supplement to Vol. III.

David Novick  
*Program Manager*  
*Securities Transactions Study*

*Santa Monica, California*  
*Winter, 1970*

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## I. BACKGROUND AND SUMMARY OF RESULTS

### Operational Problems of the Securities Industry

In 1968, the volume of trading in securities rose to unforeseen and unprecedented levels. This volume in combination with a rising price level created a period of general prosperity for the securities industry. At the same time, however, the high trading volume caused a flood of paperwork that overwhelmed the bookkeeping offices of many brokers, and associated with this problem was the growing number of failures to complete transactions on settlement day. Some informed observers were seriously concerned that the industry could not handle the paperwork anticipated as a result of even higher volumes of trading.

Records were often not updated on time, errors were at an all-time high, and customers complained to brokers, the exchanges, and the Securities and Exchange Commission (SEC) that they were not receiving stock certificates promptly or that their account records were not current. These failures to complete transactions on time caused the brokers to incur substantial costs. The Rand Corporation has estimated that these delays in completing stock transactions between brokers and between brokers and their customers in 1968 cost the 386 reporting members of the New York Stock Exchange around \$180 million<sup>1</sup> for interest and clerical expense. For that year their gross profit from agency commissions on listed and over-the-counter stocks was approximately \$300 million.<sup>2</sup>

There were other problems of concern to the securities industry at that time, such as commission rates, institutional membership in the exchanges and the National Association of Securities Dealers, and public offerings of equities in member firms, but the problem of completing transactions seemed most urgent. Therefore, when members of Rand, the American Stock Exchange (AMEX), the National Association of Securities Dealers (NASD), and the New York Stock Exchange (NYSE)

<sup>1</sup> It must be kept in mind that this cost is based on the share volumes and stock prices current in 1968 in *all* markets. The various alternatives discussed later in this summary and listed in Table 1, page 12, involve only *one* market at a time (NYSE or OTC) and share volumes and prices different from those prevailing in 1968.

<sup>2</sup> Data on gross profit from security commissions for all firms in 1968 were not available. Data reported in SEC Forms X-17A-10 may provide this information for 1969 when the tabulations are completed.

met in early 1969, the discussion centered on what Rand might do to assist the securities industry in handling its trade completion problems.<sup>3</sup> It became clear that while many solutions had been proposed, the analytical capability needed for testing and evaluating them was not available. This deficiency was one of the difficulties that prevented the securities industry from concentrating its efforts on implementing desirable improvements.

## Providing the Analytical Capability

Actual experimentation with a wide variety of system changes is not possible when the activity is as complex in nature as the trade completion process. To deal with this problem, Rand developed a unique computer simulation model and the related cost-estimating procedures that provide the means for experimentation with and analysis of the trade completion system. Therefore, it is now possible to test quickly, economically, and under near laboratory conditions many proposals that had been put forward by the industry, those that Rand developed as part of its study, and those that will be developed in the future. It is important to note that proposed changes in the trade completion system can now be tested without interfering with the actual operations.

### THE SIMULATION MODEL

Mathematical simulation has been used by Rand and the United States Air Force to solve some difficult aircraft maintenance management problems. Simulation models of this type have been used to study and gain insights into many and varied types of economic problems in the leather industry, university operations, routing studies in the transportation field, and airline maintenance and scheduling problems. It is not a new technique, but this is the first time it has been used in a comprehensive way to study the trade completion problem of the securities industry.

The Rand simulation model permits design changes in 52 characteristics of the trade completion process, such as stock delivery priorities, stock borrowing and segregating policies, stock clearing processing rules, etc. All the essential processes in the flow of stock certificates related to the settling of trades on any exchange or in the over-the-counter (OTC) market are included and can be varied at will.<sup>4</sup>

The major advantages of this model can be summarized as follows:

<sup>3</sup> Trade completion is defined to include all people and processes involved in the handling of stock certificates following the purchase or sale of a security.

<sup>4</sup> For a complete description of the model, the computer program, and the supporting data, see R. L. Petruschell, S. J. Benton, D. J. Dreyfuss, L. E. Knollmeyer, J. Y. Lu, and R. E. Stanton, *Reducing Costs of Stock Transactions: A Study of Alternative Trade Completion Systems*, Vol. III, *The Trade Completion Simulation Model*, The Rand Corporation, R-552-ST, December 1970.

1. The real system can continue to function without disruption during the experimentation process.
2. By eliminating processes of the real system that are extraneous to the problem being studied, the real effect of the proposed changes on the process under study can be more clearly observed.
3. A large number and range of changes can be examined quickly and at low cost.
4. In addition, these changes can be studied singly or in a large variety of combinations to determine their effect on the system and on each other.

A description of the tests Rand conducted will provide some insight into the range of changes that can be examined and the relative costs and benefits involved.

## **BROAD OUTLINE OF THE TESTS**

An essential step in the development of the model was the definition of incomplete transactions, or fails. The term "fails," as used in the industry, is usually limited to broker-to-broker fails. This definition was found to be too narrow for a full study of the problem because consideration of other kinds of incomplete transactions was essential for evaluating how the trade completion system functioned. Therefore, the definition was broadened to include fails between customers (individuals as well as institutions) and brokers and fails by brokers to repay a stock loan on call date.

In order to evaluate the effects of changes in trade completion processes on the level of fails and the related costs, it is necessary to have a standard or benchmark case against which to measure differences caused by the changes. Accordingly, a benchmark case was set up to represent the existing system of trading on the NYSE at a volume of about 20 million shares per day and at an average price of \$35 per share. The model was used to generate fails for the benchmark case and the cost incurred by brokers due to the fails was calculated. Then a number of alternatives were tested by introducing one or more changes and the costs of the resulting fails combined with the costs of introducing the changes were compared with the benchmark case. In the analysis of alternative clearing systems for over-the-counter stocks, a similar procedure was followed; the cost of the existing system of clearing was compared with the costs of two alternative clearing systems.

## **Results**

Rand experimented with the simulation model and the related cost-estimating procedure not only to demonstrate the way in which they could be used, but also

to show the relative value of a number of system changes.<sup>5</sup> The analyses of these changes identify modifications to the current trade completion system that could result in significant improvements in the industry's performance and in substantial benefit to brokerage firms' net operating income.

It is important to note that some of the improvements examined can be implemented only with the cooperation of customers and the banks. Some improvements can be put into effect with minimum structural change in the stock brokers' current arrangements for doing business, or they can be implemented as part of the operating procedures of a certificate depository such as the NYSE Central Certificate Service (CCS) or of a Continuous Net Settlement (CNS) system such as that now being developed by the National Clearing Corporation (NCC). When such changes are incorporated in a depository or a CNS system, additional benefits will be achieved.

The test results covered in the discussion to follow show the costs and savings for changes in the trade completion system for only one market at a time—NYSE or OTC. The relative advantages of the various alternatives may be judged by comparing the results for each set of changes with the benchmark case.

To provide an additional measure of the benefits achievable by altering existing trade completion processes, a rough estimate was made of the savings that could have been achieved in 1968 by 386 NYSE member firms. These were the firms that dealt with the public and submitted income and expense reports for 1968. As previously stated, their gross profit from security commissions on stocks in all markets because of fails of all types was estimated as \$180 million. Based on the model results, it is estimated that these firms could have saved almost \$100 million by making the improvements specified for the banks' and brokers' minimum structural change case (see page 8 and item 10 in Table 1 on page 12). The changes included in this alternative are (1) taking full advantage of the partial delivery rules, (2) reducing transfer time, and (3) reducing the fail rates for DKs,<sup>6</sup> uncomparers, and wrong denominations. These changes alone could have saved an amount of about one-third of the 1968 gross profits of the 386 member firms.

## THE TEST CASES

### Benchmark Case

The benchmark, or base, case represents the existing system operating under stress—about 20 million shares per day. Under these circumstances, it has been

<sup>5</sup> For a detailed description of these test cases and the supporting cost methods, see R. L. Petruschell, D. J. Dreyfuss, L. E. Knollmeyer, and J. Y. Lu, *Reducing Costs of Stock Transactions: A Study of Alternative Trade Completion Systems*, Vol. II, *Evaluation of Selected Alternatives*, The Rand Corporation, R-552-ST, December 1970.

<sup>6</sup> A DK occurs when stock is presented for delivery and the intended receiver refuses to accept, claiming no knowledge of the transaction. The receiver states, "I don't know the trade." In this study, the term DK was applied only to banks refusing to accept delivery from brokers.

estimated that fails of all types in NYSE-listed stocks cost the industry \$125 million per year. This comprises \$136 million in clerical expense and a net imputed interest benefit of \$11 million. For each of the various alternatives examined, the cost of fails after allowing for the cost of introducing the changes was compared with the cost for the benchmark case and the difference represented the savings resulting from the change.

The reader should focus on the relative changes in costs and savings for the various cases rather than the absolute value of the estimates. The primary value of these estimates is that they indicate the relative costs and benefits of the system changes.

### **Delivery Priorities**

When a broker does not have enough stock on hand to make all required deliveries, a decision on delivery priorities must be made. In order to operate a delivery priority system, brokers need current information on the stock certificates in their possession, expected receipts, and required deliveries. Firms with automated cages have the capability of providing themselves with the information needed. Other firms could obtain the required information through service bureaus. The cost of operating such a delivery priority system was estimated at \$8 million based on service bureau fees.

The simulation model was used to compare the effect on the cost of fails of several delivery priority systems. In the benchmark case, deliveries to institutions were given first priority, brokers second, stock loan repayment third, and cash customers last. When the delivery priority was changed so that cash customers and institutions both preceded brokers, an intolerable level of broker-to-broker fails resulted, and the cost of fails increased sixfold.

If, instead, the priority ordering is brokers, institutions, cash customers, and stock loan repayments, then broker-to-broker fails decrease significantly, but the overall cost of fails increases from the \$125 million benchmark case to \$132 million (including the cost of introducing the change). If no other system changes are introduced, the least-cost combination for delivery priorities results when deliveries are made as in the benchmark case (institutions first, etc.).

### **Transfer Time**

During the time stock certificates are in the process of having title changed, they are not available for delivery. It follows that any reduction in transfer time will increase the inventory available for brokers to use in completing deliveries to other brokers and to customers. Transfer agents can reduce the time required to complete the transfer operation by using computer-stored stock record information displayed on cathode ray tube terminals. The most tedious and time-consuming step in transfer is the retrieval of stock record data on the buyer and seller. This step can be greatly shortened (and with a concomitant improvement in accuracy) by using

large-memory computers. Other ways of reducing transfer time have been suggested. Standardizing forms and procedures, for instance, may offer additional reductions in transfer time with, perhaps, even lower cost.

The annual cost of achieving faster transfers was estimated to be \$10 million. This was determined by assuming that the ten largest New York City banks (which account for the bulk of transfers) would require \$5 million each to install computers and subsidiary equipment and to develop software programs. The \$5 million estimate was obtained from a transfer agent who had installed the type of system required. The \$10 million annual cost assumed that the \$50 million total was amortized over 5 years. The expected reduction in the operating expenses of these transfer agents was not included in the cost estimate.

The effect of reducing transfer time from 8 days to 2 days was tested. This speeding up of the transfer process would reduce the cost of fails from \$125 million, in the benchmark case, to \$91 million, for a saving of \$34 million per year. Deducting the \$10 million annual cost of this improvement reduces the savings for the trade completion system as a whole to \$24 million. It appears that reducing transfer time is an improvement with a high savings potential for the securities industry.

#### **Stock Loans**

In the model, brokers will always attempt to borrow stock to cover short sales or segregation requirements if they do not have sufficient inventory for these needs. In the benchmark case, stock loans were made for these purposes only; loans were not used to cover any fails to deliver.

Stock loan clerical costs were established by surveying the costs of a large broker who makes many stock loans. The clerical cost to the lending broker is approximately \$5 per loan. The clerical cost to the borrowing broker was assumed to be insignificant.

Alternatives were examined in which stock loans were used to cover fails-to-deliver to (1) brokers and (2) institutions. In both cases, fails were reduced, but the effect of borrowing to cover institutional fails was not great (savings of \$8 million per year after deducting the clerical cost of the loans) because the major cause of such fails—the DK—is unaffected by a stock loan policy. A more significant benefit appears when stock loans are made to cover fails-to-deliver to brokers. Stock loans reduced the base-case-fails cost of \$125 million by \$16 million when used to prevent broker-to-broker fails.

#### **Partial Deliveries**

The effect of taking full advantage of the existing industry partial delivery rules was examined next. In the benchmark case, deliveries were made only when brokers could fulfill the entire order. If a broker owed 200 shares to another broker or to a customer but had only 100 shares available, no attempt would be made to deliver the part of the order on hand.

If partial deliveries are made whenever possible, additional costs are incurred for the increased number of deliveries and the extra bookkeeping involved. Based on service bureau charges, the industry cost for the bookkeeping required due to the additional deliveries was estimated as \$6 million per year.

When it was specified that partial deliveries would be made to brokers and institutions, the cost of fails was reduced from \$125 million to \$79 million, most of the savings resulting from fewer broker-to-broker fails. Of the various individual changes tested, making partial deliveries appears to be one of the most promising areas for net cost reduction.

### **DKs, Uncompares, and Wrong Denominations**

The combined effect of reducing DKs, uncomparables, and wrong denominations was also examined. They were examined in combination because they have the common characteristic of causing delays in trade completion for reasons other than the lack of stock certificates.

DKs affect fails-to-deliver to institutional customers. They do not directly affect deliveries to brokers or cash customers. In the model, when a DK occurs, the stock used in the attempted delivery is held by the delivering broker until either the receiving bank obtains the necessary instructions or the irregularities preventing the delivery are corrected.

Since the bulk of DKs are caused by lack of instructions, transmission of instructions by an interbank wire system instead of by mail would greatly reduce this type of DK. The standard telegram charge was used to estimate an annual cost of \$6 million incurred to reduce this type of fail.

A wrong denomination means that stock must be sent to transfer in order to obtain certificates in smaller numbers of shares, e.g., a 1000 share certificate is broken down into a 100, two 200, and a 500 share certificate. During the time it is in transfer, it is removed from the inventory available for making deliveries.

In order to reduce the incidence of wrong denomination problems, brokers need an inventory of stock certificates of various denominations with continuous monitoring so that advance action can be taken to obtain certificate sizes that have been depleted. Therefore, only those firms with a large inventory can readily alleviate the wrong denomination problem by proper inventory management. It was estimated that the addition of at least one employee for each of the fifty largest firms at a total annual cost of less than \$1 million would be necessary to have an impact on this problem.

An uncomparable trade has a somewhat different impact. Until the two parties to the transaction agree to its terms, no broker-to-broker delivery is made and none is attempted. There will be a failure to complete the transaction until resolution can be accomplished.

The level of uncomparable trades for stocks listed on a major exchange can be reduced by a system like the AMEX's proposed Floor Derived Clearance System. For a similar system, it was estimated that the cost would be about \$5 million per year for the NYSE.

The combined effect of lowering the DK rate from 30 to 10 percent, the uncompare rate from 6 to 1 percent, and the wrong denomination rate from 5 to 2 percent is a reduction in net cost of \$59 million per year—from \$125 million to \$66 million.

Although each of these factors has an impact on system performance, the greatest benefit would be derived by reducing the DK rate and, hence, the level and cost of broker-to-institution fails. The annual cost of achieving improvements in these three areas would be small (\$12 million per year) in relation to the resulting saving.

### Combination Changes

The cases discussed up to this point include one change at a time from the benchmark case specifications (DKs, uncomparers, and wrong denominations being considered a single type of change). Making two or more changes at the same time produces results that reflect their interaction and, of course, will yield greater savings. Rand has examined a number of different combinations of which two examples are presented here—one involving changes only in broker operations and the other involving both brokers and banks. These are identified as minimum structural changes in order to distinguish them from the more far-reaching changes involved in certificate depositories and nationwide clearing for OTC stocks.

*Minimum Structural Change—Brokers Only.* The purpose of this combination was to explore the effects of system changes that did not assume bank action to reduce transfer time and the DK rate. Brokers were assumed to (1) take full advantage of the partial delivery rules, (2) give first priority to broker deliveries, and (3) use stock loans to cover fails to institutions. This combination reduced the cost of fails from \$125 million to \$89 million for a net saving of \$36 million. This is a substantial saving but still much less than is possible if brokers' improvements are combined with banks' reductions in transfer time and the DK rate. This is shown in the following case.

*Minimum Structural Change—Banks and Brokers.* For this combination case it was assumed that both the brokers and the banks modified their operating procedures by (1) fully implementing the partial delivery rules, (2) giving first priority to deliveries to institutions, (3) reducing transfer time, and (4) reducing the rates for DKs, uncomparers, and wrong denominations. After allowing for the cost of these changes, the net cost of fails would be reduced from the benchmark total of \$125 million to \$36 million, a net saving of \$89 million for trading in NYSE-listed stocks alone.

### Stock Certificate Depositories

To explore the impact of certificate depositories on the trade completion system, two cases were examined, one identified as a limited and the other as a full

depository. The basic difference between the limited and full depositories is the extent to which banks and customers participate. For details on the differences between the two depository cases, see items 11 and 12 in Table 1 (page 12). It should be noted that the improvements included in the preceding case (minimum structural change—banks and brokers) and shown as item 10 in the table are also applied in the two depository cases, along with additional changes intended to reflect depository operations.

*Limited Depository.* The limited depository case represents current plans for CCS development. It was assumed that brokers participated fully, that major New York City banks participated to the extent of receiving and delivering stocks, and that institutional and cash customers' holdings outside the depository remained the same. Specifications for this case include mandatory stock loans to cover broker-to-broker fails, first priority for delivery to institutions, full implementation of the partial delivery rules, fast transfer and reduced rates for DKs, uncomparables, and wrong denominations.

The cost of all the improvements included in the limited depository case (item 11 in Table 1) was \$50 million of which \$20 million was for the depository operations alone. The balance of \$30 million covered the costs of improvements in transfer time, delivery priorities, and DK, uncompare, and wrong denomination rates. It was assumed that the depository would facilitate partial deliveries without additional cost to the brokers. The net effect was to reduce the cost of fails from \$125 million for the benchmark case to \$30 million for the limited depository—a saving of \$95 million.

The \$95 million saving for the limited depository is not much greater than the saving of \$89 million found for the banks' and brokers' minimum structural change case (items 10 and 11 in Table 1). The added saving due to the limited depository operation was small primarily because the industry incurs additional costs for the new system at a time when it is not able to obtain the saving of a full-scale depository that would relieve the brokers of most of the costs of handling stock certificates.

*Full Depository.* To test the implications of a full depository it was assumed that 85 percent of the institutional and cash customers would leave their stock certificates in the depository. Also, it was expected that the benefits to be derived from faster transfers, partial deliveries, stock loans to cover broker-to-broker fails, and lower rates for DKs, uncomparables, and wrong denominations would be achieved at lower cost or to a greater degree through an effective and comprehensive depository. In addition, there are substantial added advantages when bookkeeping entries replace actual certificate deliveries.

The incremental costs attributable to the operation of the depository are \$51 million, which includes costs for depository operations (\$20 million), maintaining additional customer accounts (\$20 million), reducing uncomparables (\$5 million), and reducing DKs (\$6 million). Some of the improvement costs are not itemized since they are included in total operating costs for the depository.

The net cost of fails for the full depository is \$53 million before allowing for the reduction in brokers' operations department costs that would result from the substitution of bookkeeping entries for the physical movement of stock certificates. It is estimated that savings in cage operations alone could amount to \$36 million per year. Subtracting that amount reduces the net cost of fails for the full depository alternative to \$17 million per year (item 12 in Table 1) in contrast to the benchmark case's \$125 million.

### Comparison of OTC Clearing Systems

All available data indicate that the dollar value of fails in relation to trading volume is greater for OTC securities than for listed securities. Experience with the NOTC clearing operation in the New York area shows that, at least locally, substantial improvements can be obtained by organizing a clearing function for OTC securities. Approximately 35 percent of OTC trades were being cleared through a clearing facility and 65 percent through the mails at the time Rand compared the costs of different clearing systems for OTC stocks. These percentages were obtained from NASD.

The cost of implementing OTC clearing systems includes the cost of clearing-related back office operations, clearing, and the cost of settlement because, when securities are shipped draft attached, settlement costs are quite significant. Back office costs and settlement charges were estimated on the basis of data obtained from a number of OTC firms. Information was obtained from the NOTC (daily net) on clearing and settlement charges, and from the Pacific Coast Stock Exchange on charges for CNS. The cost of fails associated with this existing mode of clearing is estimated to be \$91 million per year (at an assumed average OTC daily trading volume of 13 million shares).

If the daily net clearing concept of NOTC were expanded to include the bulk of the large trading firms outside New York City, then the net cost of fails would decline to \$65 million per year for a saving of \$26 million annually. However, the maximum saving will occur when the CNS clearing and settlement system of the National Clearing Corporation goes into effect. It is estimated that the saving, net of the cost of improvements, will be \$52 million per year over the current methods when this system is fully operational.

### SUMMARY

The cases covered in the preceding discussion are summarized in Table 1, page 12. Each case is identified by a number and a brief title in the columns at the left of the table. The upper part of the table (items 1 through 12) pertains to trade completion alternatives for NYSE stocks; the lower part of the table (items 13 through 15) pertains to alternatives for OTC stocks with emphasis on different clearing systems. Under the general caption "Inputs" are shown the assumptions

made for the benchmark case and the changes made for each of the alternatives tested. A blank space in any input column means that the input for the benchmark case was also used for the alternative case. Whenever an input for a particular case was altered, the substitute input appears in the table. For example, a DK rate of 30 percent for broker-to-bank deliveries was specified for the benchmark case but was reduced to 10 percent for the alternative in which fail rates were changed (item 8). Under the caption "Total Net Cost" the total clerical and interest costs incurred by brokers because of fails plus the net costs of modifying the trade completion system are shown. The last column shows the difference in total net cost due to the changes identified. For the NYSE stocks, the total net cost for each case is compared with the benchmark cost of \$125 million. For the OTC cases (items 14 and 15), total net costs are compared with the cost of \$91 million for the existing OTC clearing system (item 13).

As the summary table and the preceding discussion show, some alternatives are much more advantageous than others. Action to improve the trade completion system should begin with those changes promising the largest benefit. This should not be interpreted to mean that the less promising changes should be ignored or deferred simply because the saving potential is less. Even though the benefits of combined changes will usually be less than the sum of the savings resulting from single individual changes, the combination changes will yield the largest benefits. For example, the alternative identified as the minimum structural change—banks and brokers (item 10)—yields a saving almost as great as that for a limited depository (item 11). A fully developed depository will provide an additional saving. The point to be emphasized is that significant improvements can be made either independently of a depository or embodied in a depository; the improvements analyzed are consistent with the depository concept and would not have to be cancelled when a depository is fully implemented. Also, development of a nationwide clearing system for OTC stocks does not mean that the benefits shown for the test cases are no longer applicable. Some improvements can be made within a relatively short time and then incorporated with a full depository or OTC clearing system when they become fully operational at a later date.

It is important to recognize that the capability to evaluate a wide range of alternative trade completion systems has now been created. We have demonstrated the usefulness of this capability by applying it to a number of possibilities that seem important. There are without doubt many more that should be and now can be considered in similar fashion. A number of these are outlined in the next section.

Table 1  
SUMMARY OF COST OF FAILS AND INPUT CHANGES FOR ALTERNATIVE TRADE COMPLETION SYSTEMS

Alternatives	Inputs										Annual Cost of Fails (\$ millions)	
	Stock Loans to Cover Fails	Delivery Priorities	Partial Deliveries	Transfer Time (days)	DK Rate (%)	Uncompare Rate (%)	Wrong Denom. Rate (%)	Cash Customers Leaving Stk. with Brokers (%)	Total Net Cost	Net Change in Cost		
New York Stock Exchange Listed Stocks												
1 Benchmark	None	IBSC	None	8	30	6	5	10	\$125	---		
2 Del. Priorities		CIBS							739	+614		
3 Del. Priorities		BICS							132	+7		
4 Stock loans	Inst.								117	-8		
5 Stock loans	Brokers								109	-16		
6 Transfer time				2					101	-24		
7 Partial del.			All <sup>a</sup>						79	-46		
8 Fail rates			All <sup>a</sup>		10	1	2		66	-59		
9 Combinations	Inst.	BISC	All <sup>a</sup>						89	-36		
10 Combinations			All <sup>a</sup>		10	1	2		36	-89		
11 Depository-broker	Brokers		All <sup>a</sup>		5	1	2		30	-95		
12 Full depository	Brokers	BSCI	Brokers	2	2	1	1	85 <sup>b</sup>	17	-108		
Over-the-Counter Stocks												
13 Existing system												
14 Expanded daily net clearing	Inst.					15	15		91	---		
15 Continuous net	Inst. and brokers		Brokers			8	10		65	-26		

NOTE: Delivery priorities are identified by a four letter group showing order of delivery for broker-to-broker, B; broker-to-institution, I; broker-to-cash customer, C; and broker repayment of a stock loan, S. Blank data spaces indicate that the input in the given alternative is the same as for the Benchmark case.

<sup>a</sup>The word "All" in the Partial Deliveries column means that partial deliveries were made to brokers and institutional customers but not to cash customers.

<sup>b</sup>This applies to both cash and institutional customers.

## II. FUTURE USE OF THE ANALYTICAL METHOD

This report has presented a number of examples demonstrating how the analytical tools Rand developed can be used to evaluate alternative trade completion systems. Of the alternatives considered, some have been identified as promising much greater savings than others. There remain a number of other alternatives that can be evaluated by using the model and the related cost methodology. These studies can be done with only minor modifications in the methodology already developed by Rand.

In its present form the model can be used to

- Evaluate the effects on the industry and on firms of the changing relative importance of institutional and cash customers as to market share.
- Evaluate the effects of changes in the extent to which cash customers leave their securities in the custody of brokers.
- Evaluate the effects of changes in the number and size of brokerage firms on the trade completion process.
- Study in greater depth the effect of the size of brokers' free inventory on the level of fails.
- Study the effects on the industry of a variety of patterns of day-to-day fluctuations in trading volumes.
- Experiment with various time distributions for the repayment of stock loans, the delivery of certificates by customers to their brokers, the resolution of DKs and uncomparers, etc. The distributions used were based on actual data but it might be fruitful to test the sensitivity of the fails level to changes in these distributions.

With modification of the model, studies in the following areas would be possible:

- The effect of changes in the commission rate structure on firms of various types.

- The effects of changes in the rules for calculating segregation requirements on the level and cost of fails.
- The possibility of developing indicators of serious adverse trends in the industry's processing capacity.

These suggestions do not exhaust the list of possible studies, but they indicate that, in addition to those covered in this report, there are many important areas where the simulation model could be utilized profitably. It is certain that additional areas will suggest themselves as the results of these studies are examined. Thus, properly used, this new capability will help to reveal fruitful areas for exploration as well as to provide information on which constructive changes and cost savings can be based.



