Journal of Hazardous Materials, 33 (1993) 339–353
Elsevier Science Publishers B.V., Amsterdam

Evaluation of the administrative efficiency of environmental laws: A statistical analysis of the New Jersey ECRA processing times

Donald N. Merino and Michael D. Antonucci

Stevens Institute of Technology, Castle Point on the Hudson, Hoboken, NJ 07030 (USA)

(Received April 20, 1992; accepted in revised form July 20, 1992)

Abstract

As environmental laws are enacted, and the U.S. and various state Departments of Environmental Protection (DEP's) establish procedures for enforcement, questions about government effectiveness in administering these laws naturally arise. The State of New Jersey has passed a law (Environmental Cleanup Responsibility Act — ECRA) that mandates the state DEP review all land transfers to ensure that sites meet environmental standards. New Jersey is the only state in the U.S. that has such a comprehensive law. Several articles have been written regarding the delays caused by this law [1–3]. The research in this paper analyzes the time it takes to process ECRA applications. Data obtained from the New Jersey Department of Environmental Protection and Energy (NJDEPE) files were statistically analyzed and forecasts made for the most serious cases (Low, Medium, and High Environmental Concern cases). Since many of the cases had not been settled, these data are considered censored [4]. Censored data refers to a data set where some of the data is actual while some data is yet to be determined. The results show that the NJDEPE takes from one to as many as four years on average to resolve a case. In the view of industrial realtors and developers these times are substantial. In the view of the NJDEPE these times are required to assure that the law is enforced properly. The research was funded by the Hazardous Substance Research Management Center (HSMRC). This type of analysis can be used to judge the relative effectiveness of the law in terms of the administrative time it takes to process ECRA applications.

Introduction

The business community of New Jersey has raised many concerns about the ECRA law [5,8–12,14]. Although the benefits, including a cleaner environment, are viewed favorably, the costs appear to be substantial. Claims have been made that ECRA is a major contributor to, if not directly responsible for, the downturn in the economy of New Jersey (cf. [5], p. 3). The reason for this

Correspondence to: Prof. D.N. Merino, Department of Engineering Management, Stevens Institute of Technology, Castle Point on the Hudson, Hoboken, NJ 07030 (USA). Tel.: 201-216-5384; Fax: 201-216-5385.

concern is the time and complexity involved in the processing of applications by the NJDEPE. Governor Florio of New Jersey has recognized this position and requested changes in the ECRA law (cf. [6], p. 34).

The NJDEPE reports that approximately 85% of all applications submitted to the ECRA program are completed within a two week period [7]. Although this is a factual statement, it is misleading. The 85% referred to by the NJDEPE are applications that are required to be filed under ECRA legislation but have very little environmental concern. Almost all of the other 15% that are not settled immediately are major cases.

This paper examines the time it takes the NJDEPE to process major ECRA applications. In order to accomplish this objective, a statistical analysis has been performed to determine the number of days it takes to process the various categories of ECRA applications (Low Environmental Concern (LEC), Medium Environmental Concern (MEC), High Environmental Concern (HEC)).

The number of days to process applications is not necessarily an index of the efficiency of the ECRA program since there is no standard to measure against. The year-to-year trend for each individual category (LEC, MEC, HEC) can be used as a relative measure of how efficient the NJDEPE is processing ECRA applications.

Objectives

The major objectives of this paper are:

(1) To ascertain the time that the NJDEPE takes to process ECRA applications.
(2) To compare trends in processing times for the years 1984–1990.
(3) To determine if there are significant differences in processing times with regard to the NJDEPE categorization of the case as LEC, MEC, HEC.
(4) To evaluate the forecasting methodology.

Methodology

Data were obtained from the NJDEPE containing cases that could be classified as resolved, unresolved, and "other". The cases considered resolved were coded by the NJDEPE with a "C" or "N", for Cleanup Plan and Negative Declaration, respectively, and were analyzed using standard statistical tools such as regressions, averages, and standard deviations.

Cases with the codes "I", "A", or "S" (Initial Notice, Assigned, and Sampling Plan Approval, respectively) were designated as unresolved. These cases could not be treated as easily, as they presented a problem similar to the 'light bulb problem'. Using the past history of a light bulb's life expectancy can be used to predict the life span of a light bulb in use. This type of a data set is known as censored data. Dr. Arthur Shapiro, of the Management Department of Stevens Institute of Technology, who was consulted on the statistical analysis requirements recommended censored data analysis [4].

The cases designated as "other" had one of the following codes: "W", "R", "M", "L", "F", "D", and "E" (Withdrawal, Enforcement Referrals, CMS Referral, Early Filer, Duplicate, and Exempt, respectively). They were not included in the analysis since they could not be considered as open or closed.

To determine the average processing time and related statistics for the entire data set (censored and uncensored) a forecast was needed, of when the uncompleted cases could be expected to be settled using the completed cases as a basis. These forecasted data were then added to the completed set. After looking at a number of forecasting techniques we chose the cumulative number of unresolved cases, as the basis of forecasting. Thus, the cumulative number of unresolved cases serves as the ordinate while the number of days is the abscissa. Using the cumulative number of unresolved cases has the effect of smoothing the data. A detailed explanation of this process is given in Appendix 1.

An exponential curve was fitted to the data and used to forecast when the unresolved cases would be settled (see Appendix 1). A number of tests were performed to determine how well the curve fit the data (goodness of fit). The results indicated that the estimating curves were a good fit.

Results

I. Estimation of time taken to process applications

Data for the processing times of applications for ALL (LEC+MEC+HEC), LEC, MEC, and HEC cases are summarized in Tables 1, 2, 3, and 4. The corresponding graphs are placed at the end of this paper.

TABLE 1

Summary statistics for ALL cases

Year	1984	1985	1986	1987	1988	1989	1990
ALL Cases	464	828	1244	1130	1286	1044	1074
Cases							
Closed[a]	332	557	883	814	860	699	443
Open[b]	12	45	101	107	128	238	495
Other	120	226	260	209	228	137	146
Days to resolve completed cases only							
Avg.	403	510	384	321	287	192	109
Std Dev	635	566	393	325	233	143	73
Estimate of days for completed and incomplete cases							
Avg.	446	700	607	476	517	446	528
R^2[c]	0.874	0.964	0.953	0.958	0.969	0.905	0.879

[a] Closed cases are those resolved by the NJDEPE.
[b] Open case are those still pending at some stage of approval by NJDEPE.
[c] R^2 = coefficient of determination (% variation explained).

TABLE 2

Summary statistics for LEC cases

Year	1984	1985	1986	1987	1988	1989	1990
LEC Cases	232	394	676	562	513	432	493
Cases							
Closed	204	314	625	535	480	404	362
Open	0	0	0	0	0	2	85
Other	28	80	51	27	33	26	46
Days to resolve completed cases only							
Avg.	99	165	189	143	162	124	95
Std.	110	149	145	117	136	83	63
Estimate of days for completed and incomplete cases							
Avg.	*	*	*	*	*	138	186
R^2	*	*	*	*	*	0.978	0.878

* Not applicable.

TABLE 3

Summary statistics for MEC cases

Year	1984	1985	1986	1987	1988	1989	1990
MEC Cases	*	*	*	*	*	329	319
Cases							
Closed	*	*	*	*	*	212	72
Open	*	*	*	*	*	82	188
Other	*	*	*	*	*	35	59
Days to resolve completed cases only							
Avg.	*	*	*	*	*	274	175
Std.	*	*	*	*	*	133	83
Estimate of days for completed and incomplete cases							
Avg.	*	*	*	*	*	476	*
R^2	*	*	*	*	*	0.977	*

* Not applicable.

II. Comparison of trends in processing times

Overall, the trend in average processing time for ECRA applications revealed an initial increase (1985 versus 1984) followed by decrease (1986 through 1990). Thus, it would appear that the NJDEPE is making progress in efficiently processing applications, even as the volume has grown to over 1,000 applications

TABLE 4

Summary statistics for HEC cases

Year	1984	1985	1986	1987	1988	1989	1990
HEC Cases	242	407	437	428	449	117	93
Cases							
Closed	127	236	213	255	258	18	2
Open	13	42	107	88	120	83	83
Other	102	129	117	85	71	16	8
Days to resolve completed cases only							
Avg.	883	946	639	656	457	512	141
Std.	805	599	295	321	233	139	37
Estimate of days for completed and incomplete cases							
Avg.	959	1134	1452	992	828	*	*
R^2	0.877	0.949	0.986	0.987	0.984	*	*

* Not applicable.

a year [13]. The efforts of the NJDEPE to better classify applications (LEC, MEC, HEC) has aided in this decreasing trend for processing times.

III. Differences in processing times for categories

Further, as would be expected, the longest processing times are for HEC cases, followed by MEC cases and then LEC cases. The absence of MEC cases for 1984–1988 is explained by the fact that the subdivision of MEC was only created in 1988 and is represented as (*) for 'not applicable'. The other areas labelled 'not applicable' represent an inability to statistically analyze the sample because of its small size.

IV. Evaluation of forecasting method

To evaluate the forecasting method we used a "step back" technique, that is the beginning portion of the actual data was used to forecast the latter period. The forecast of this latter period was then compared with the actual history to evaluate our forecast. For example, the closed cases data of 1986 were used to forecast those cases that were begun in 1986 and remained unresolved by December 31, 1986.

Table 5 summarizes the results of the forecast evaluation. The magnitude of the overestimates fairly matched the magnitude of the underestimates. The exact differences can be seen in Tables 6 and 7 and the percentage difference is tabulated in Tables 8 and 9.

For ALL cases the forecast was very close for all years except 1986. When it was predicted that the NJDEPE would resolve more cases than they did. The error of the estimate for this year was approximately 28%. For the HEC cases the forecast was close to the actual history.

TABLE 5

Summary of forecasting evaluation

Year	Case type	Result—NJDEPE resolves:
1984	ALL	More cases than forecast predicted
1985	ALL	More cases than forecast predicted
1986	ALL	Less cases than forecast predicted
1987	ALL	Less cases than forecast predicted
1984	HEC	More cases than forecast predicted
1985	HEC	More cases than forecast predicted

TABLE 6

Number of ALL cases resolved in forecast evaluation

Year	Start[a]	End[b]		
		Forecast	Actual	Difference
1984	45	21	12	9
1985	127	49	44	5
1986	201	43	101	−58
1987	241	41	107	−66

[a] Start: denotes the cumulative number of unresolved cases at the beginning of the comparison time.
[b] End: denotes the cumulative number of unresolved cases at the end of the comparison time.

TABLE 7

Number of HEC cases resolved in forecast evaluation

Year	Start	End		
		Forecast	Actual	Difference
1984	45	29	11	18
1985	120	72	42	30

Tables 8 and 9 represent the average number of days needed to resolve cases within the evaluation window (October 1988 and January 1991). The averages were calculated by summing the number of days used to resolve all cases within the period and dividing it by the number of cases resolved.

Verification could only be done for the years shown. Estimates could not be made for years and categories not shown in the above verification.

TABLE 8

Average number of days to resolve — ALL cases

Year	Forecast	Actual	Act. − For.	Diff. / Act.
1984	2007	2055	+48	+2.3%
1985	1681	1694	+13	+0.8%
1986	1346	1851	+505	+27.3%
1987	939	1002	+63	+6.3%

TABLE 9

Average number of days to resolve cases — HEC cases

Year	Forecast	Actual	Act. − For.	Diff. / Act.
1984	2108	2078	−30	−1.4%
1985	1774	1693	−81	−4.8%

Conclusions

Forecasts both overestimated and underestimated the actual history of processing times. The accuracy of the forecasts when compared to the actual varied from 0.8% to 27.3%. However, all forecasts, except those for the year 1986 — ALL Cases, were within 7% of the actual. Thus, the modified exponential forecasting method can be assumed to adequately predict processing time.

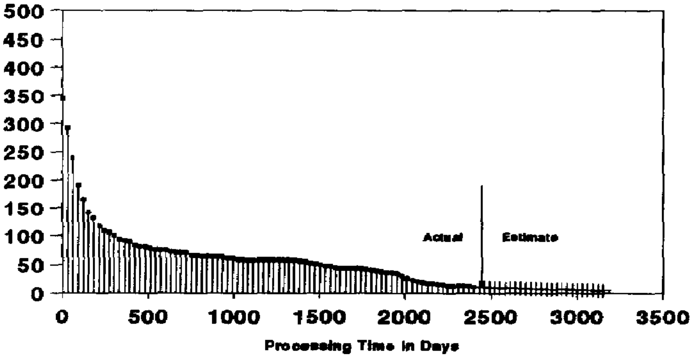

Fig. 1. 1984 — ALL cases. Total no. of cases = 464, completed cases avg. (days) = 403, standard deviation = 635, no. of open cases = 12, coeff. of determination = 0.8740, estimated avg. (days) = 446.

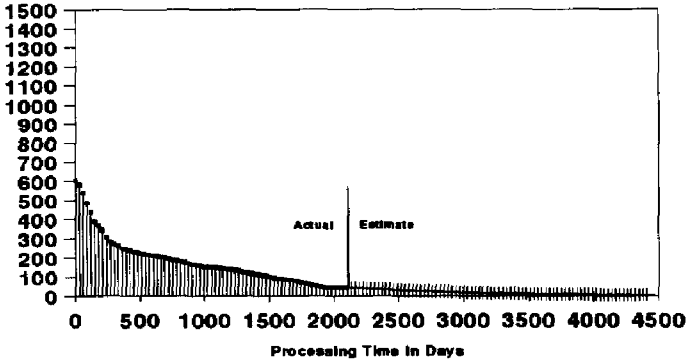

Fig. 2. 1985 — ALL cases. Total no. of cases = 828, completed cases avg. (days) = 510, standard deviation = 566, no. of open cases = 45, coeff. of determination = 0.9635, estimated avg. (days) = 700.

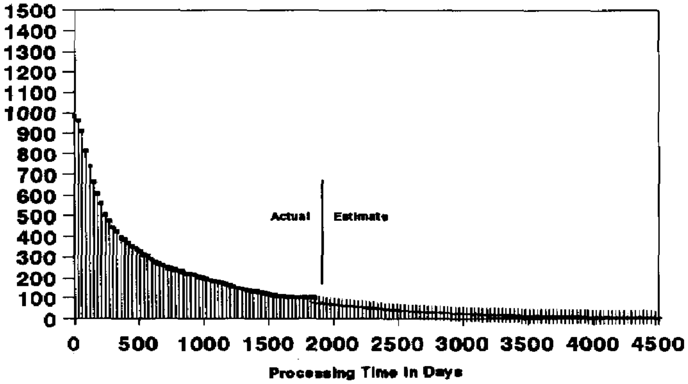

Fig. 3. 1986 — ALL cases. Total no. of cases = 1244, completed cases avg. (days) = 384, standard deviation = 394, no. of open cases = 101, coeff. of determination = 0.9527, estimated avg. (days) = 607.

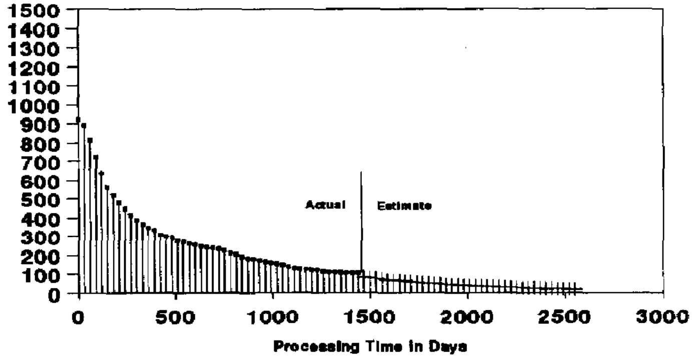

Fig. 4. 1987 — ALL data. Total no. of cases = 1130, completed cases avg. (days) = 321, standard deviation = 325, no. of cases open = 107, coeff. of determination = 0.9576, estimated avg. (days) = 476.

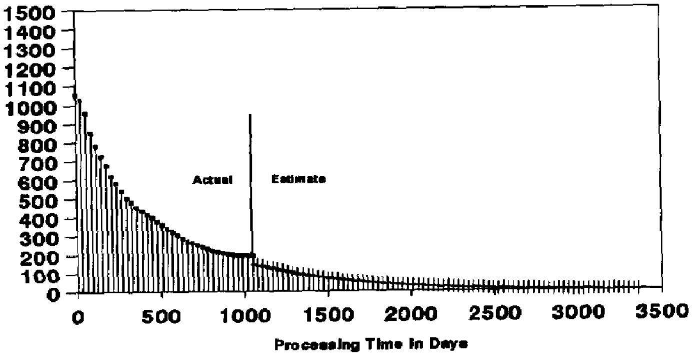

Fig. 5. 1988 — ALL cases. Total no. of cases = 1286, completed cases avg. (days) = 287, standard deviation = 233, no. of open cases = 194, coeff. of determination = 0.9691, estimated avg. (days) = 517.

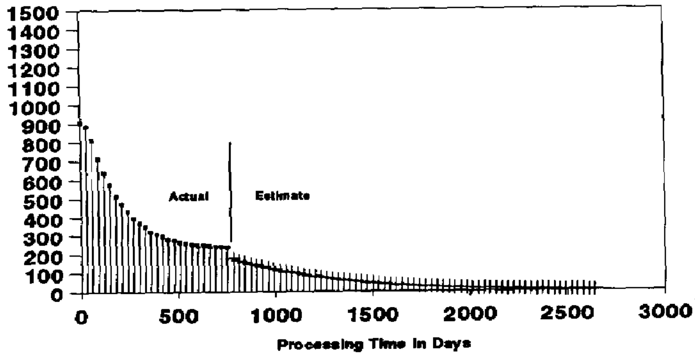

Fig. 6. 1989 — ALL cases. Total no. of cases = 907, completed cases avg. (days) = 192, standard deviation = 143, no. of open cases = 238, coeff. of determination = 0.9048, estimated avg. (days) = 446.

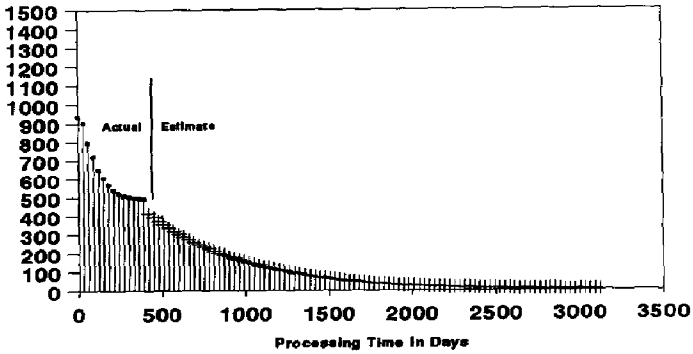

Fig. 7. 1990 — ALL cases. Total no. of cases = 938, completed cases avg. (days) = 109, standard deviation = 73, no. of open cases = 495, coeff. of determination = 0.8786, estimated avg. (days) = 528.

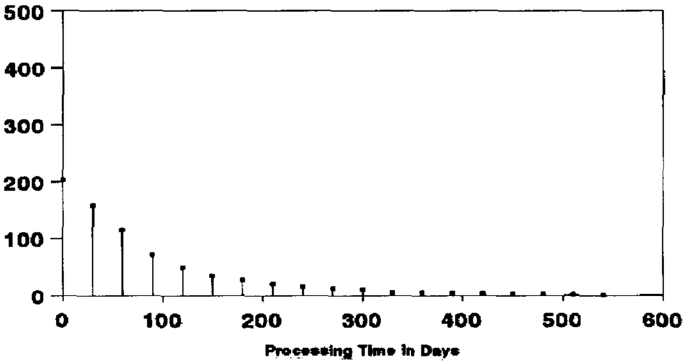

Fig. 8. 1984 — LEC cases. Total no. of cases = 204, completed cases avg. (days) = 99, standard deviation = 110, no. of open cases = 0.

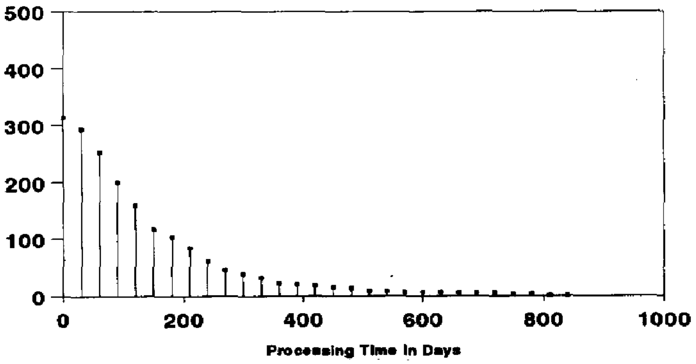

Fig. 9. 1985 — LEC cases. Total no. of cases = 314, completed cases avg. (days) = 165, standard deviation = 149, no. of open cases = 0.

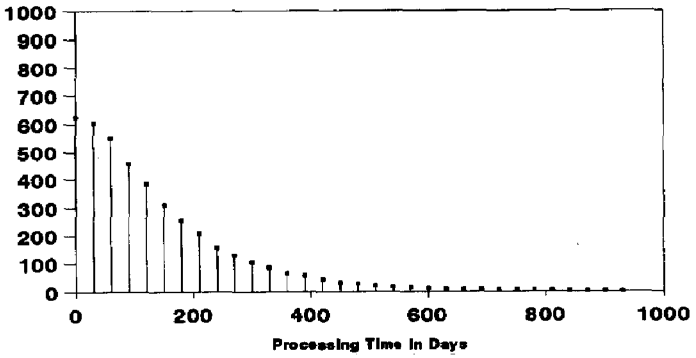

Fig. 10. 1986 — LEC cases. Total no. of cases = 625, completed cases avg. (days) = 189, standard deviation = 145, no. of open cases = 0.

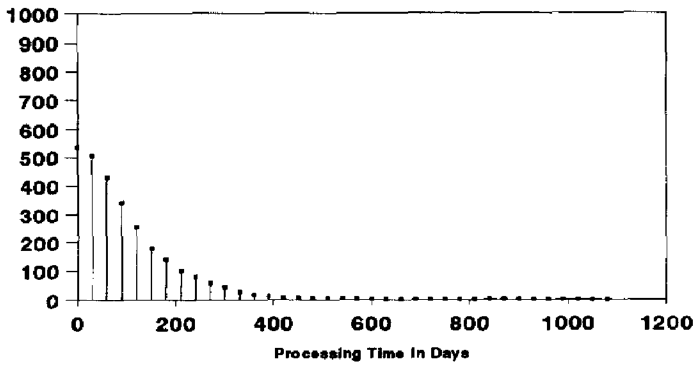

Fig. 11. 1987 — LEC cases. Total no. of cases = 535, completed cases avg. (days) = 143, standard deviation = 117, no. of open cases = 0.

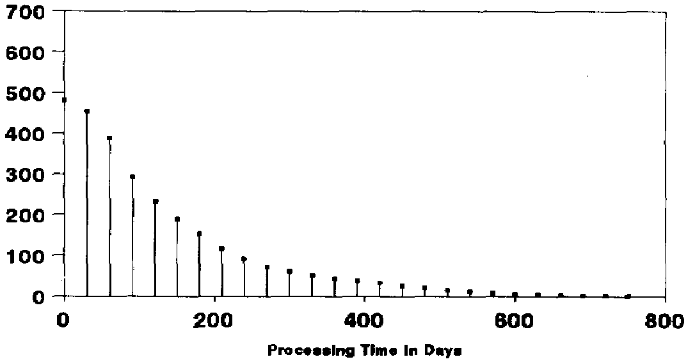

Fig. 12. 1988 — LEC cases. Total no. of cases = 480, completed cases avg. (days) = 162, standard deviation = 136, no. of open cases = 0.

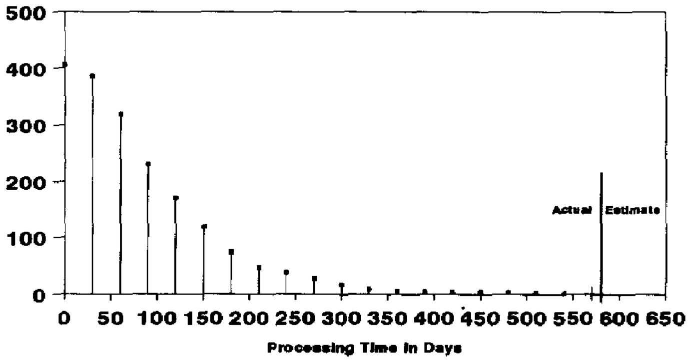

Fig. 13. 1989 — LEC cases. Total no. of cases = 406, completed cases avg. (days) = 124, standard deviation = 83, no. of incomplete cases = 2, coeff. of determination = 0.9789, estimated avg. (days) = 138.

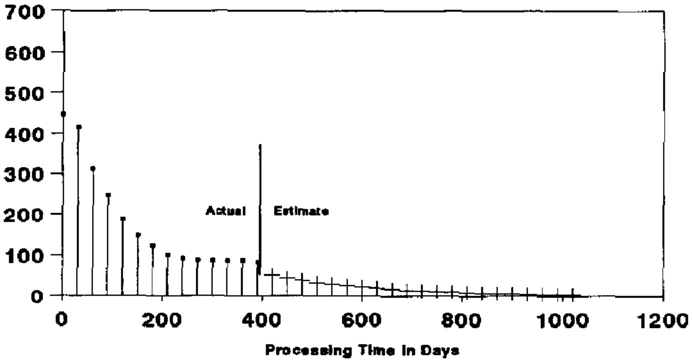

Fig. 14. 1990 — LEC cases. Total no. of cases = 447, completed cases avg. (days) = 95, standard deviation = 63, no. of open cases = 85, coeff. of determination = 0.8776, estimated avg. (days) = 186.

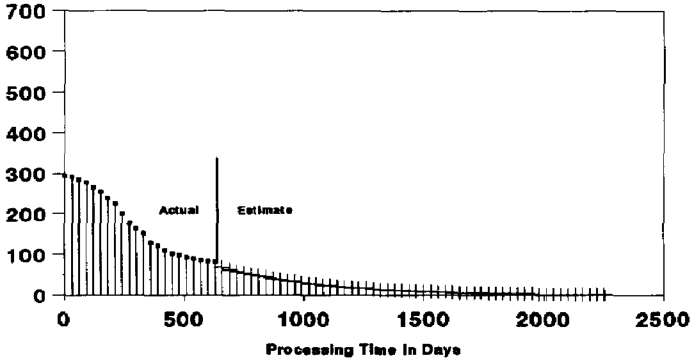

Fig. 15. 1989 — MEC cases. Total no. of cases = 294, completed cases avg. (days) = 274, standard deviation = 133, no. of open cases = 82, coeff. of determination = 0.9768, estimated avg. (days) = 476.

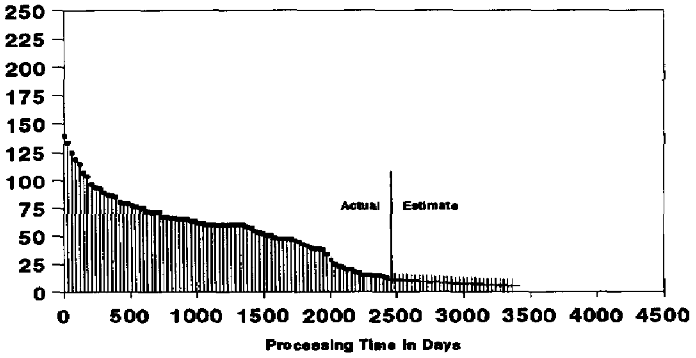

Fig. 16. 1984 — HEC cases. Total no. of cases = 140, completed cases avg. (days) = 883, standard deviation = 805, no. of open cases = 13, coeff. of determination = 0.8773, estimated avg. (days) = 959.

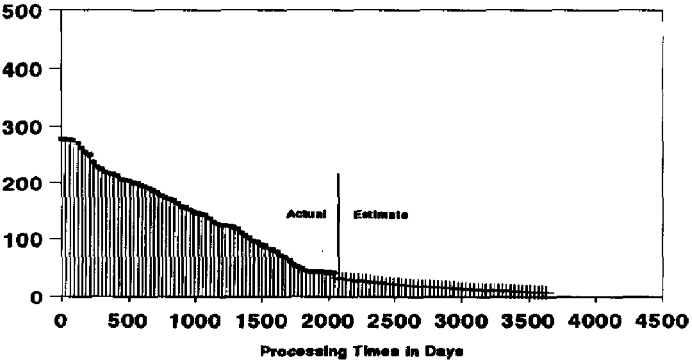

Fig. 17. 1985 — HEC cases. Total no. of cases = 278, completed cases avg. (days) = 946, standard deviation = 599, no. of open cases = 41, coeff. of determination = 0.9495, estimated avg. (days) = 1134.

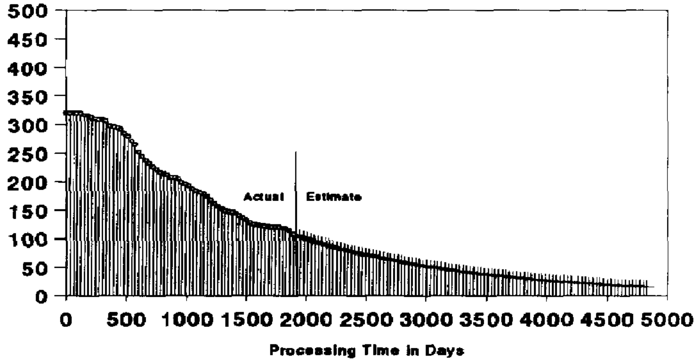

Fig. 18. 1986 — HEC cases. Total no. of cases = 320, completed cases avg. (days) = 639, standard deviation = 295, no. of open cases = 107, coeff. of determination = 0.9864, estimated avg. (days) = 1452.

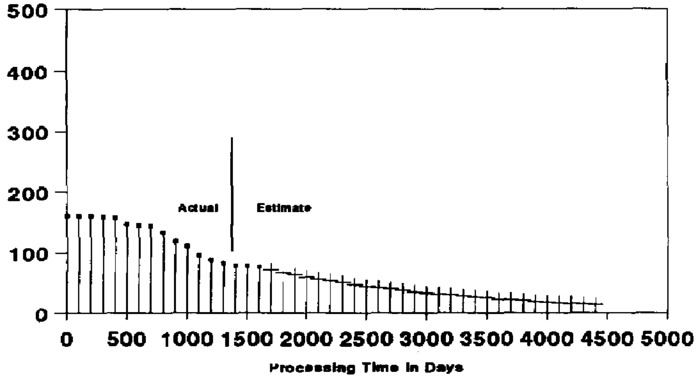

Fig. 19. 1987 — HEC cases. Total no. of cases = 161, completed cases avg. (days) = 883, standard deviation = 290, no. of open cases = 78, coeff. of determination = 0.9288, estimated avg. (days) = 1845.

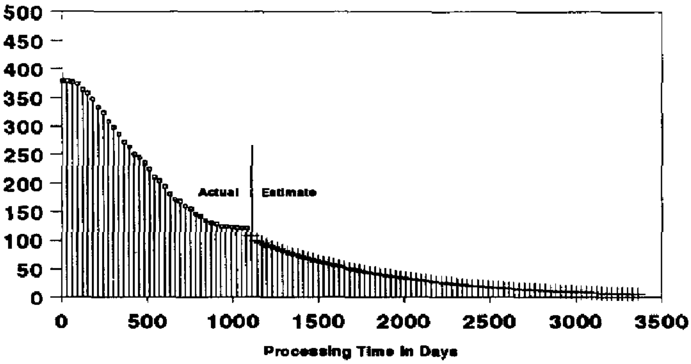

Fig. 20. 1988 — HEC cases. Total no. of cases = 378, completed cases avg. (days) = 457, standard deviation = 233, no. of open cases = 120, coeff. of determination = 0.9836, estimated avg. (days) = 828.

References

1 A. Ashkinaze, Coping with ECRA's growth: Large caseloads, staffing at issue, New Jersey Law J., 121(13) (1988) 46.
2 A. Berger, The ECRA mess, New Jersey Success, 10 (1990) 34.
3 A. Biesada, A cautionary tale, Financial World, 159(2) (1990) 46.
4 A. Shapiro, Personal communication, Stevens Institute of Technology, Hoboken, NJ.
5 B. Murray, Bankruptcy issue, ECRA Update, 3(2) (1991) 3.
6 R. Schwaneburg, Florio joining foes of environmental cleanup law, Newark Star Ledger, June 3 (1992) 15.
7 Industrial Site Evaluation Element, ECRA report – FY 1989, New Jersey Department of Environmental Protection, Trenton, NJ, 1989.
8 D. Farer, ECRA verdict: The success and failures of the premiere environmental law, Pace Environ. Law Rev. 5(1) (1987) 113.
9 D. Gill, Divided they stand, Business J. New Jersey, 7 (1989) 21.
10 D. Gill, Expediting the ECRA cleanup process, Business J. New Jersey, 7 (1989) A19.
11 E.A. Hogan, The ECRA threat, Business J. New Jersey, 7 (1989) 15.
12 R. Lesniak, ECRA is coming, New Jersey Lawyer, 104 (1983) 41.
13 L. Miller, ECRA: A manager's view of the cleanup statute: Improvements in efficiency, New Jersey Law J., 123(13) (1989) 54.
14 H.J. Olson and K. Kneis, ECRA applicability: Traps for the unwary, New Jersey Law J., 125 (1990) 68.

Appendix 1

The following steps outline the procedure involved in analyzing the data:

(i) Cumulative number of unresolved cases vs. time
The cumulative number of unresolved cases was plotted vs. time for the completed data. The result was a decaying exponential curve with the following characteristic equation.

(ii) Equation

$$y = \exp\,(Ax + b)$$

$$\ln y = Ax + b$$

$$Y = Ax + b$$

where, $Y = \ln y$, y = cumulative number of unresolved cases at a time t, x = time in number of days

(iii) Regression analysis

A regression analysis using LOTUS 1-2-3, was then performed to evaluate the coefficient (A) of x, the constant (b) and the coefficient of determination.

(iv) Estimate of resolution of pending cases

Using the above equation with a calculated x-coefficient and a constant for a given year, it was then possible to make an estimate as to when the pending cases would be resolved.

(v) Estimated average

The results were tabulated as below.

Days D_i	*No. of cases* f_i	$D_i \times f_i$
50	20	1000

This means that between 0 to 50 days, 20 cases were resolved.

$$\text{Estimated average} = \frac{\Sigma D_i \times f_i}{\Sigma f_i}.$$

(vi) Coefficient of determination

The coefficient of determination is the percentage of the variation that is explained by the forecast line. The coefficient of determination for the extrapolated 1991 data varied from a low of 87.7% to a high of 98.7%, that is, the variation explained by the curve ranged from 87.7% to 98.7%. For the 1988 data, the coefficient of determination ranges from 71.4% to 98.6%. These values indicate a ‘goodness of fit’ for the curves. Typically, a value of less than 50% is questionable while values greater than 50% provide better fits. Coefficients of determination greater than 80% indicate a high degree of fit between the actual and forecasted data.