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1.0 Abstract

By improving the Failure Analysis process of IBM media tape drives a projected $612,000 will be saved annually. This improvement in the process requires no capital expenditures and is simply improving upon the current Failure Analysis (FA) process.

2.0 Introduction

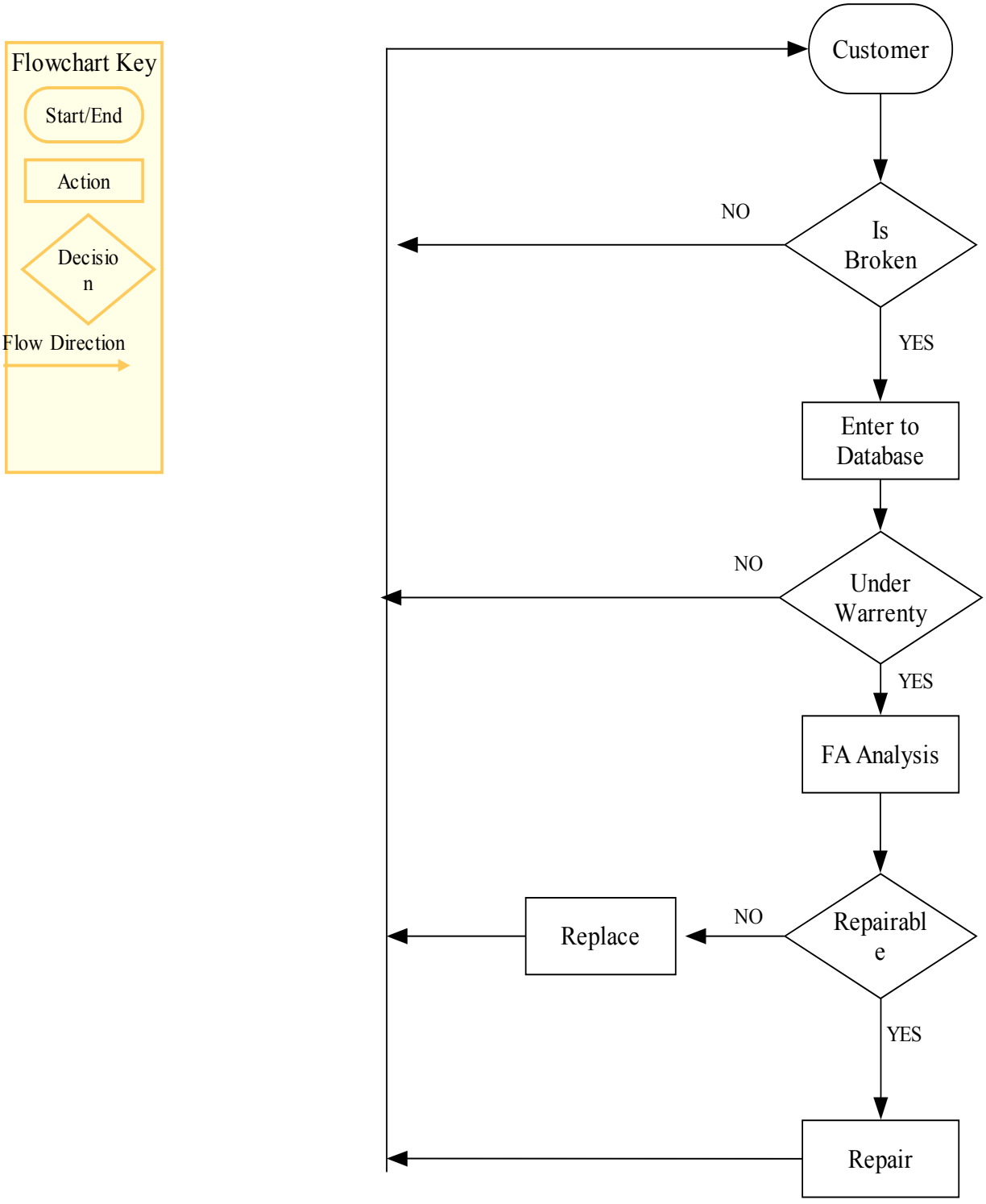
Among the myriad of products IBM produces are media storage devices, or more specifically, media tape drives. These drives have the capability to quickly and cheaply read and write data to magnetic media tape. However, as with most products, these drives suffer damage or failure within the warranty period. These failed drives are then sent to a Failure Analysis Laboratory in Tucson, Arizona to identify the root cause of the failure. This information is fed into, and tracked in a database. Management is interested in a process analysis of this data to gain better insight into the nature of the failures, to be able to forecast problem areas and alleviate future potential problems, and to staff appropriately for response to drive failures.

Available is the actual and true data on the number of damaged drives Received, In-Process, and Closed over a twenty week period of time. Received is simply the number of damaged drives that arrive at the Failure Analysis Laboratory. In-Process is the designation for drives that are being analyzed for root cause of failure. Closed identifies the drives that have been analyzed and designated with a root cause of failure. Root causes are divided into eight categories and are the following: Code, Customer Process, Head, HW Electrical, HW Mechanical, IBM Process, Media and NDF (non-identifiable).

3.0 Current Process

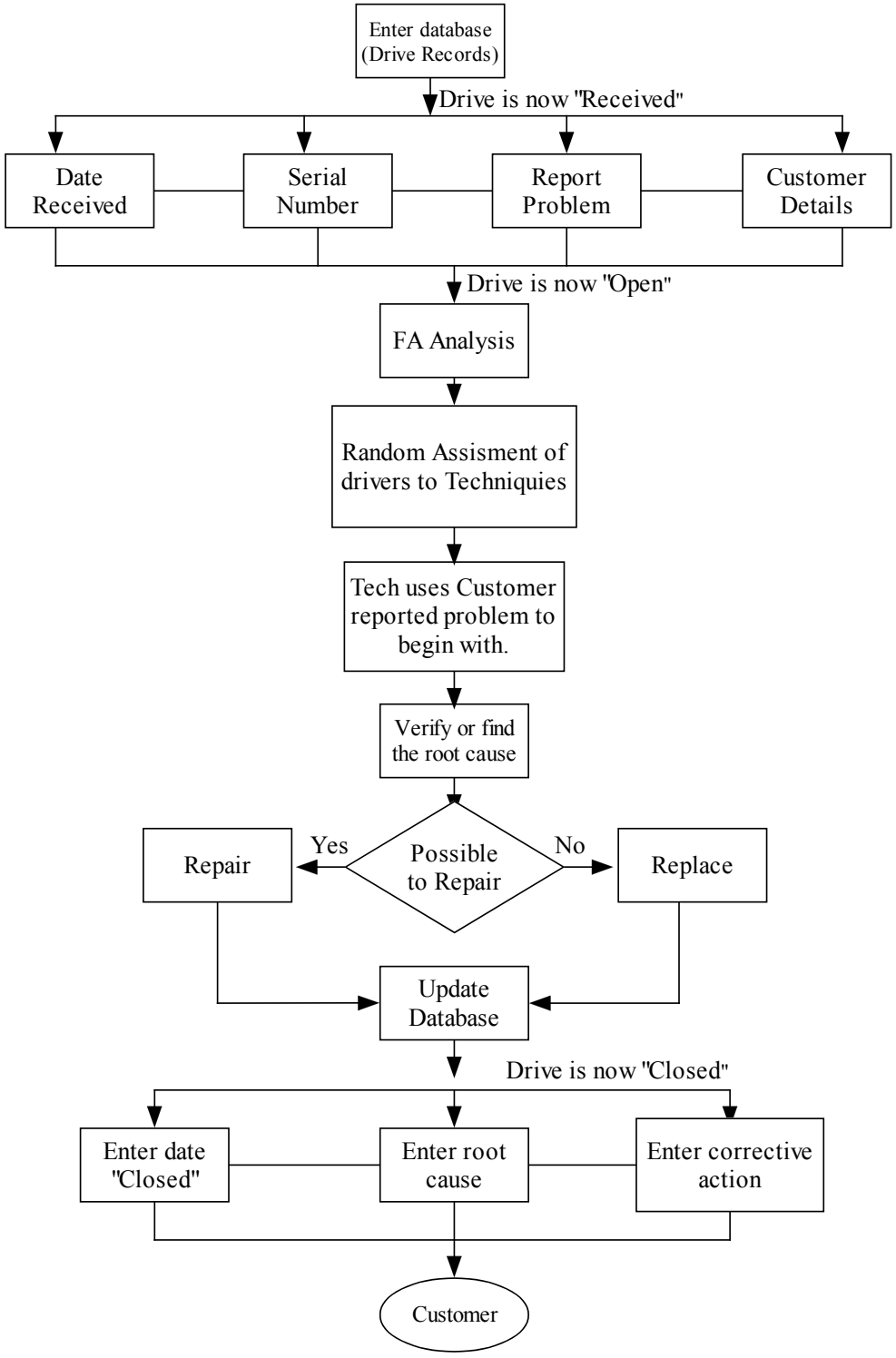
The current process is fairly linear and is easily diagrammed using a flow chart. The process is easily understood by focusing on the macro and micro portions of the failure analysis process (See Figure 3.1 and Figure 3.2). Under the macro view, the FA lab receives the drive from the customer. If the drive is damaged is it entered into the FA database. If it is under warranty the drive is analyzed to identify the root cause of failure. In addition, a typical warranty is for one year from the date of purchase. From there it is either repaired or replaced dependent upon the root cause of failure.

Figure 3.1 Macro View Current Process.



Within the micro view, specifically concentrating upon the FA database and FA analysis, several activities occur simultaneously. Information enters the database such as the date received, the serial number, customer name, and the customer reported problem. As the information enters the database the drive is considered "Received." Now, a randomly selected technician will begin the failure analysis on the drive, using the customer reported problem as a starting point. The technician will identify the root cause and then repair the drive if possible or replace it. The database is updated by the responsible technician to include the data closed, root cause, and the technician will enter a corrective action. The root cause is normally one of eight possibilities as discussed earlier. The corrective action will be one of six possibilities: Customer training, Engineering Change, Hardware, Micro code, PCN, and Test Enhancement.

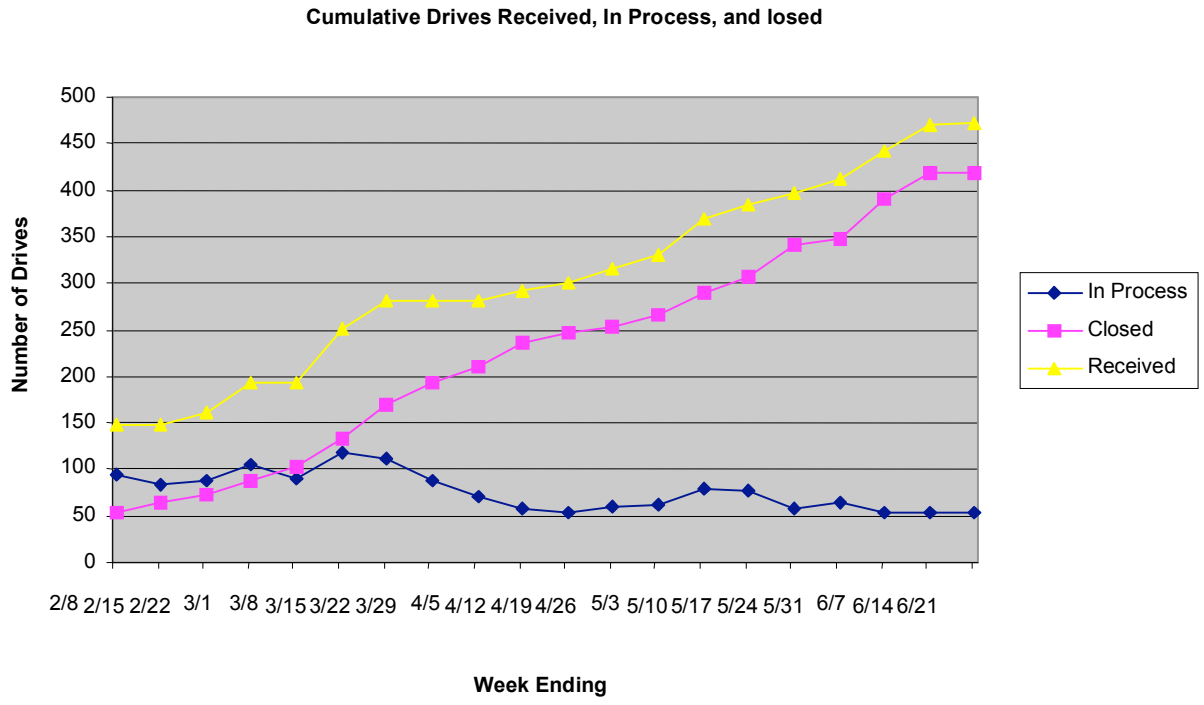
Figure 3.2 Micro View Current Process.



4.0 Results and Data Analysis

Below is a chart showing the drives Received, In Progress and Closed for the current process over a twenty week period (See Fig. 4.1). Note the large amount of drives In Progress, fifty four to be exact. This is a large amount of drives by a small team of technicians to be repairing. Also note that the amount of In Progress has decreased over time, however, this decline has been stagnant for several weeks and in some weeks actually increased. Clearly, the total number of drives In Progress must be minimized and a redesign of the FA process must be initiated.

Figure 4.1 Cumulative Drives Received, In Process, and Closed.



5.0 Improved Process

There are four areas in which a change in process is in order. The goal is to reduce expenses and reduce time required for failure analysis. Thus the recommended four process changes are as follows (See Fig. 5.1). First, assign drive to a technician by skill based upon the customer reported problem. Second, assign a severity level with a respective repair by date (See Fig. 5.2). If date cannot be achieved then replace drive as a cost saver. Also, allow some flexibility in repair by dates and severity level. For example, an important customer may warrant greater attention or a contractual agreement for repair may also warrant greater attention. Third, train technicians based upon most frequent root cause of failure and skill level required to repair complex or expensive parts. This information may be easily parsed from the FA database as Root Cause of Failure (See Fig. 5.3). Fourth, order parts based upon the information entered into the database cause of failure and recycle parts from other drives whenever possible. For example, if one part is used to replace a failed part, then use than information from data parsing from the database for the next parts purchase and for recycling of parts. Parsing information such as Corrective Action (See Fig. 5.4) is useful information for understanding potential problems and for executive decisions regarding supplier relations, customer relations, marketing, and product lines. Moreover, this parsed data should be presented at the weekly status meeting for employee involvement and feedback, and the parsed data should be sent out in monthly e-mail reports to managers and employees of who repaired or replaced what drives, and were the repair by dates achieved.

Figure 5.1 Improved Process

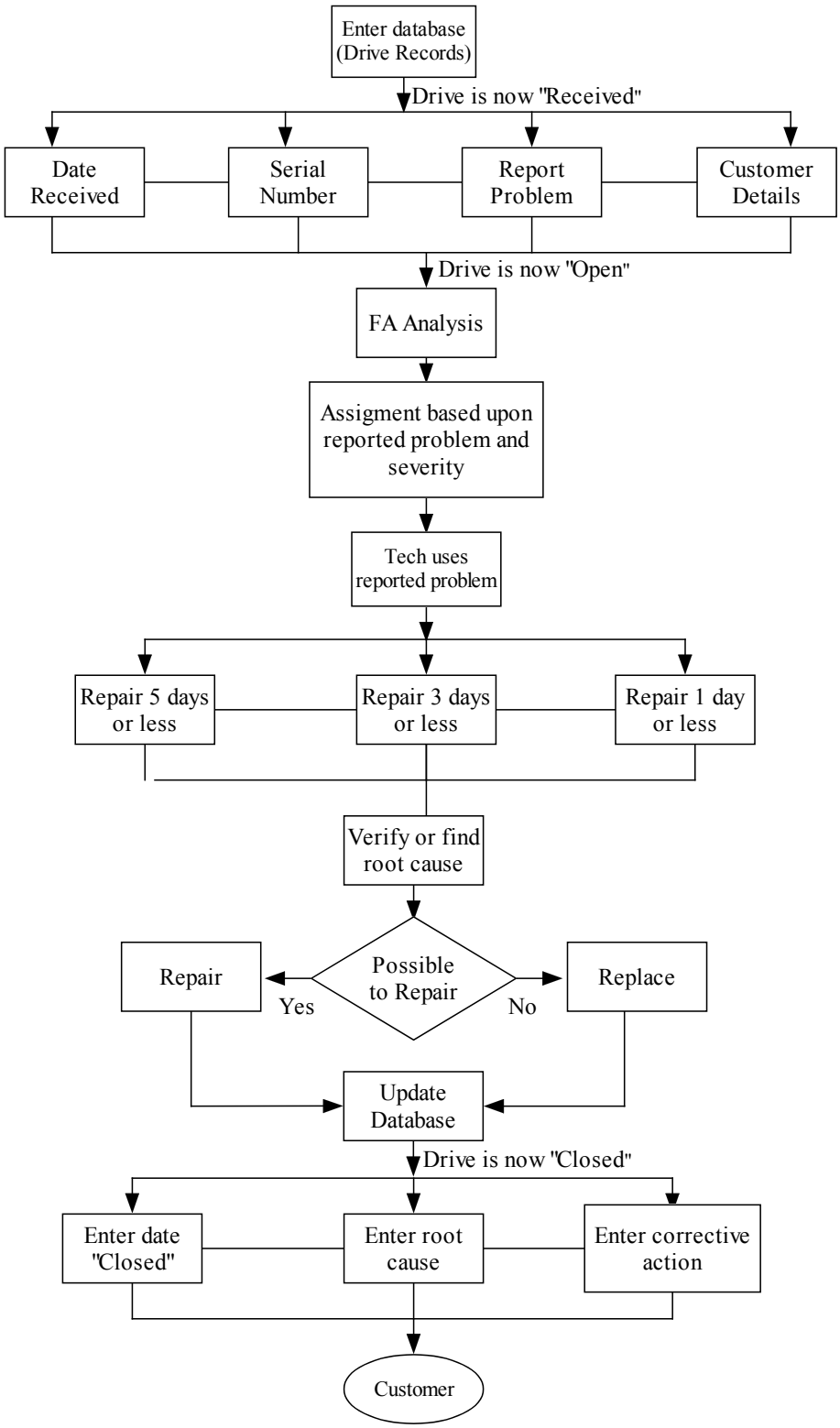


Figure 5.1 Repair by Date

Repair by Date	Severity Level	Description
1 day	1 Low	Low cost part, easy to access damaged area.
3 days	2 Medium	Medium cost part, some difficulty to access damage.
5 days	3 High	High cost part, difficult to access damaged area.

Figure 5.3 Root Cause of Failure.

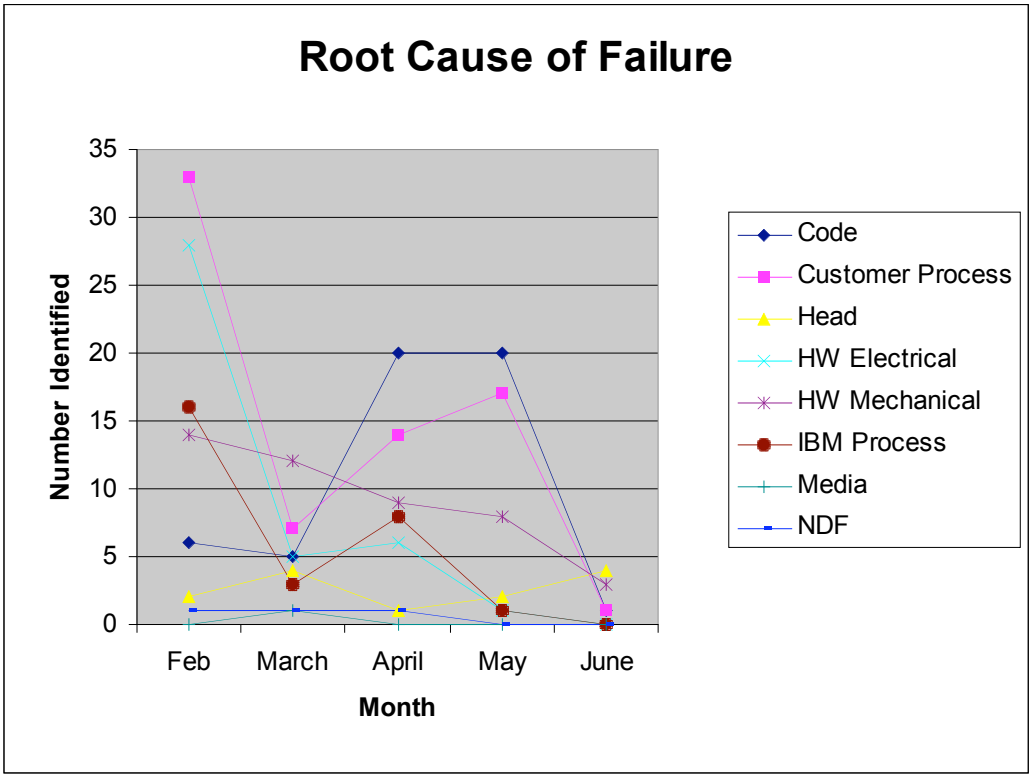
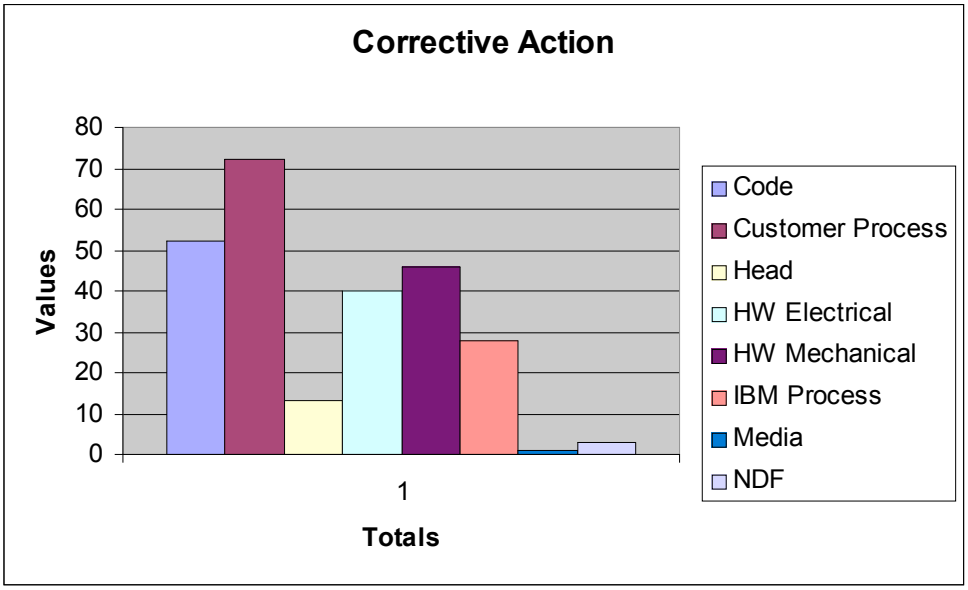
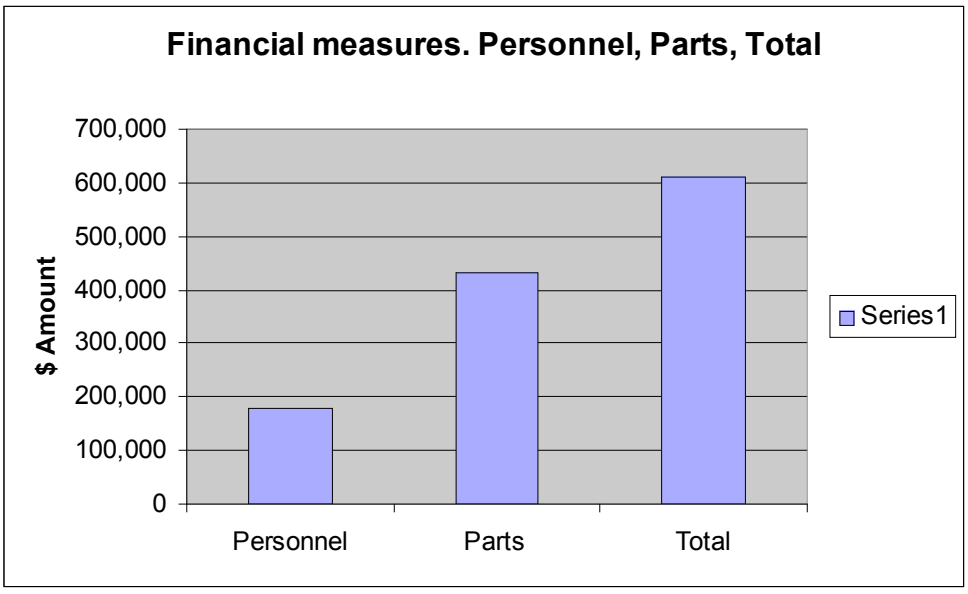


Figure 5.4 Corrective Action.



6.0 Key Performance Indicators

The ultimate goal is to reduce expenses and reduce time required for failure analysis resulting in reduced expense. The key performance indicators are described as: First, the cumulative totals for drives Received should closely as possible equal drives Closed. Second, drives in Process will have an assigned severity level, assigned technician, and must be competed by the severity level date or be replaced. The methodology is that it will be cheaper to replace than repair, reducing valuable man hours spent on repair. Third, parse the database for Root Cause of Failure and Corrective Action. This parsing will aid in problem prevention, drive refinement, appropriate staffing and training, customer relations, parts requisition, and executive decisions. Fourth, the projected dollars saved from the suggested process will save $612,000 annually. The financial measures may be quantified as follows. Through assignment of drives and repair by dates $180,000 will be saved on personnel hours. Moreover, through the recycling and reselling of parts an additional $432,000 will be saved on parts requisition.



7.0 Conclusion

Simply by improving upon the failure analysis process $612,000 will be saved annually. This improvement requires no capital expenditures, increases capability and reduces In Process time. Moreover, parsing of the database is an effective and efficient aid for understanding potential problems, drive refinement, parts requisition, staffing and executive decisions.

Appendix

Raw Data

Week	In Process	Closed	Received
2/8/06	94	54	148
2/15/06	84	65	149
2/22/06	88	73	161
3/1/06	105	88	193
3/8/06	90	103	193
3/15/06	119	133	252
3/22/06	111	170	281
3/29/06	88	194	282
4/5/06	71	211	282
4/12/06	57	235	292
4/19/06	53	247	300
4/26/06	61	254	315
5/3/06	63	267	330
5/10/06	80	290	370
5/17/06	78	306	384
5/24/06	57	341	398
5/31/06	65	348	413
6/7/06	53	390	443
6/14/06	53	418	471
6/21/06	54	419	473

In Process		*Closed*		*Received*	
Mean	76.2	Mean	230.25	Mean	306.5
Standard Error	4.628061	Standard Error	26.57619	Standard Error	23.26783
Median	74.5	Median	241	Median	296
Mode	53	Mode	#N/A	Mode	193
Std. Dev.	20.69732	Std. Dev.	118.8524	Std. Dev.	104.0569
Sample Var.	428.3789	Sample Var.	14125.88	Sample Var.	10827.84
Kurtosis	-0.71529	Kurtosis	-1.13101	Kurtosis	-0.99086
Skewness	0.571244	Skewness	0.038908	Skewness	0.011159
Range	66	Range	365	Range	325
Minimum	53	Minimum	54	Minimum	148
Maximum	119	Maximum	419	Maximum	473
Sum	1524	Sum	4605	Sum	6130
Count	20	Count	20	Count	20
Largest(1)	119	Largest(1)	419	Largest(1)	473
Smallest(1)	53	Smallest(1)	54	Smallest(1)	148

Code		*Customer Process*		*Head*		*HW Electrical*		*HW Mechanical*		*IBM Pro*
Mean	10.4	Mean	14.4	Mean	2.6	Mean	8	Mean	9.2	Mean
Std. Error	4.007	Std. Error	5.418	Std. Error	0.6	Std. Error	5.128	Std. Error	1.881	Std. Error
Median	6	Median	14	Median	2	Median	5	Median	9	Median
Mode	20	Mode	#N/A	Mode	2	Mode	#N/A	Mode	#N/A	Mode
Std. Dev.	8.961	Std. Dev.	12.116	Std. Dev.	1.3416	Std. Dev.	11.467	Std. Dev.	4.207	Std. Dev.
Samp Var	80.3	Samp Var	146.8	Samp Var	1.8	Samp Var	131.5	Samp Var	17.7	Samp Var
Kurtosis	-2.956	Kurtosis	0.9891	Kurtosis	-2.4074	Kurtosis	4.043	Kurtosis	0.267	Kurtosis
Skewness	0.403	Skewness	0.8530	Skewness	0.1656	Skewness	1.965	Skewness	-0.602	Skewness
Range	19	Range	32	Range	3	Range	28	Range	11	Range
Minimum	1	Minimum	1	Minimum	1	Minimum	0	Minimum	3	Minimum
Maximum	20	Maximum	33	Maximum	4	Maximum	28	Maximum	14	Maximum