Proactive maintenance and reactive repair

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ABSTRACT

Each month a major US telephone company receives 200 000 calls from customers who have a problem with their telephone service. The company places a high emphasis on reducing the repair cost caused by the high volume of complaints. Using a simulation model, the company wants to understand how more proactive maintenance can reduce the need for repair calls.

The simulation model presented in this paper reveals that within proactive maintenance we need to distinguish between at least 3 different policy levers: (1) Discover the problem before the customer notices it; (2) Do the repair with such a quality that you do not have to repair the same problem twice.; (3) Make your physical plant more reliable. Each of the 3 policies will have different cost savings and different payoff delays. The simulation model allows the company to allocate investments in each of the 3 areas and to test which investment mix fits the overall company objectives best.

INTRODUCTION

Imagine you are the head of maintenance for a large regional phone carrier. You're in charge of the repair and maintenance of over 14 million phone lines, of which 220 thousand have trouble each month. Headquarters has given you a mandate to reduce that figure by 20% over the next 3 years. To accomplish this, you have assembled a cross-functional team which has met several times. So far the team has generated a whole list of counter measures, such as providing more training to your repair technicians or investing in more reliable cable technology and you have had some heated discussions about the relative benefit of each one. But other than conflicting data and anecdotal evidence, you have no way of testing the relative benefits of each measure, or of seeing what combination of actions will have the greatest benefit.

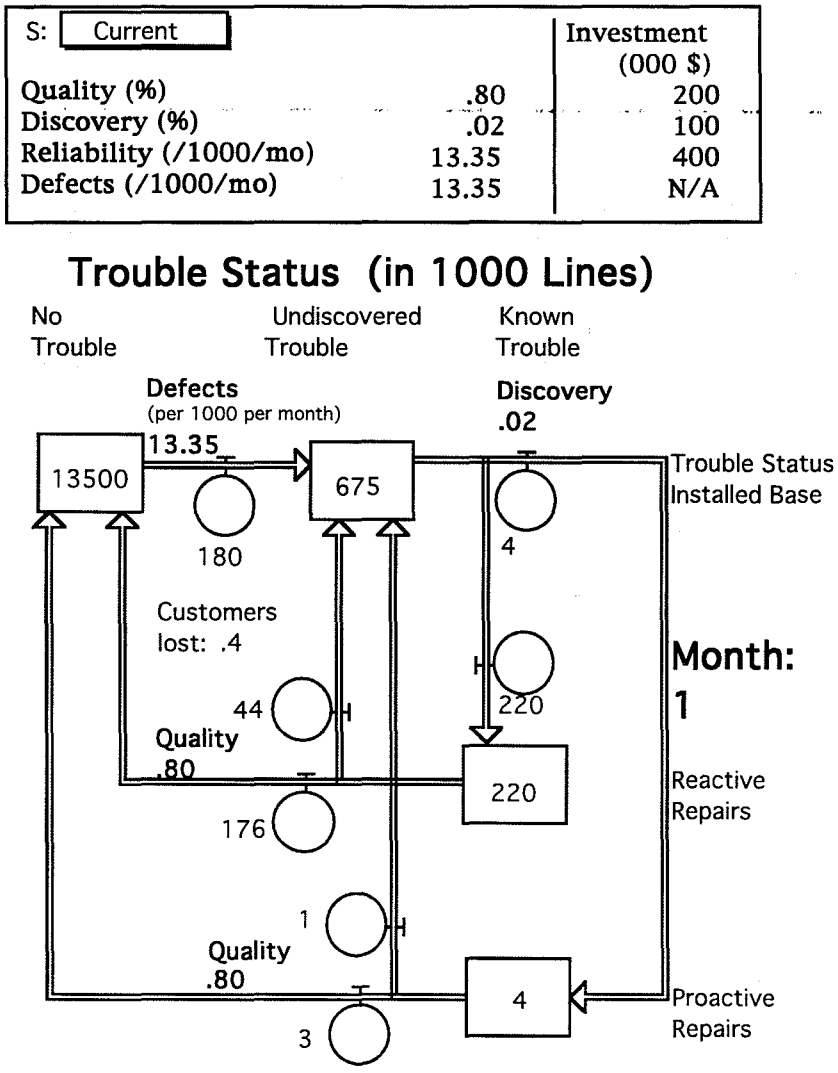
What you need is a tool that will give you some way to look at the various maintenance strategies in a cohesive way. To assist in this process, your MIS department has given you a new computer simulator, which enables you to experiment with alternative scenarios and see the output in reports that are identical to the maintenance reports you view on a monthly basis. You call your team together for an afternoon meeting, in which you plan to use the simulator to see the relative outcomes of each strategy.

BACKGROUND

The author found himself placed in a similar context as the one described above when he was asked to help in the design of such a computer simulation. One of the most important learning occurred during the development of Figure 1 that breaks down the 14.4 million lines into four main categories: lines that don't have a problem; "re-active repairs," which

have been initiated by customer complaints; "pro-active repairs," which are the problems the company discovered before the customer did; and those lines that are not showing problems yet, but are anticipated to cause problems within the next three months.

Figure 1: Overview screen



Rather than continue thinking in terms of one long list of counter-measures, the development team began to see each item on the list as falling into one of three distinct categories:

- *Discovery*. Currently, the company only discovers 2% of all problems, while the customers uncover 98% of all problems. Investing in discovery means taking measures to increase the number of proactive repairs that the company makes, in order to reduce the number of problems that customers call in.

- *Quality*. Past data has shown that, of the 220 thousand lines repaired each month, 20 percent of them were not fixed properly and will need service again in three months.

Efforts such as investing in training and creating more standardized repair procedures could boost quality and reduce the need for future repairs.

- *Reliability.* A number of factors in the initial installation of phone lines, such as the materials used and the location of the lines, that affect the expected failure rate of the phone lines. By investing in reliability, you can prevent problems before they occur.

COMPARING INVESTMENT STRATEGIES

All of those counter measures are not free, however. Your current maintenance budget is $700,000 per month, of which you are currently spending $100,000 on discovery (proactive maintenance), $200,000 on quality, $400,000 on that reliability. Management has allocated $300,000 more maintenance budget over the next several years. The question facing you and your team is, of the three categories outlined above, where should you allocate your money in order to maximize the savings gained by the investments.

The simulator contains an interface that provides a comparison with the current "base case" strategy. Figures 2-5 depict a scenario where we invest $1,000,000 in quality and nothing in discovery or reliability.

Figure 2: Maintenance cost screen

S: Current

Monthly Report

	COST (000$)	VOLUME (000)	UNITCOST ($)
Trouble Repair			
Proactive	0	0	20
Reactive	14114	235	60
Investments			
Trouble Discovery	0		
Repair Quality	1000		
Reliability	0		
Total	15114		

Month 50

Figure 3: Cost comparison screen

Cost Comparison (000 $)
Month: 50

Monthly

	Current	BaseCase	Difference
Lost Revenue			
Lost Customers	765	1132	-367
Lost Access Time	396	370	26
Maintenance Cost			
Repair Cost	14114	13260	854
Investments	1000	700	300
Total	16275	15461	813

Figure 4: Cost per month comparison

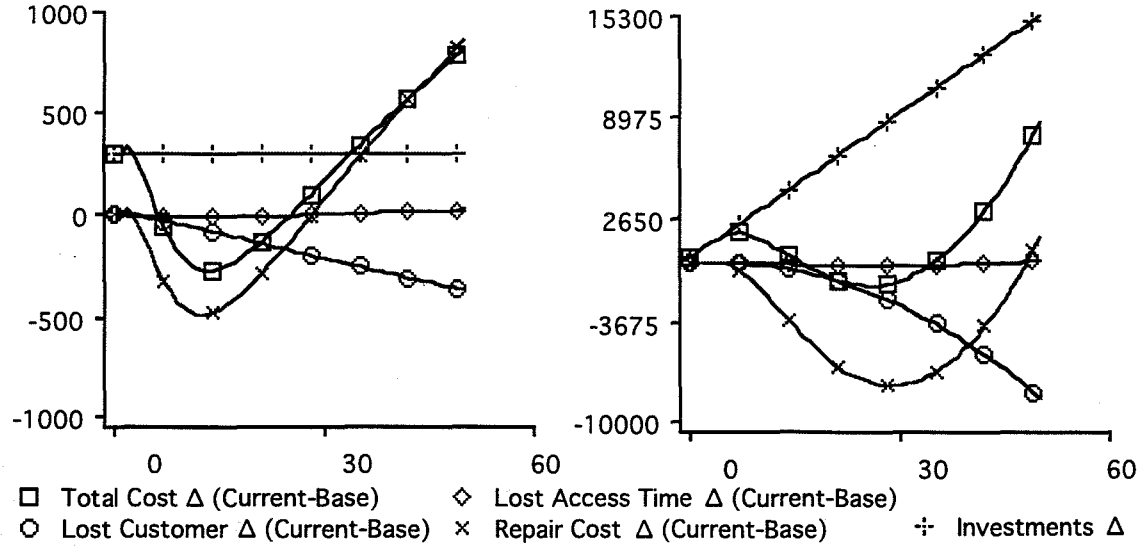


Figure 5: Accumulated cost comparison

Comparing scenarios reveals that not all maintenance efforts are created equal. Figure 6 compares 3 different investment strategies to the base case. In each case we have added $400K to the monthly investments made in either quality, discovery, or reliability.

Figure 6: Comparison against Base Case

	Month when total payoff>0	Total payoff in month 60	Payoff in month 60	Repairs (% BC) in month 60	Lost Customers
Base Case	N/A	0	0	100.0	1331
BC + $300K for Quality	19	17141	536	95.4	1024
BC + $300K for Reliability	36	21439	1213	88.6	1259
BC + $300K for Discovery	10	19595	441	100.0	1232

Investment in reliability provides us with the biggest payoff ($21,439,000) and the largest on-going benefits ($1,213,000). At month 60, repair volume has shrunk to 88.6% of the base case and continues to fall. Under the current assumptions, investment in discovery has the quickest payoff. It reduces cost, since it is assumed that it is less expensive to repair a mistake if you schedule your repairs in advance. However, the total number of repairs to be made remain constant. The simulator makes the assumption that some customers leave us for a competitor if they have to endure the same repair twice or more often within 3 months. A investment in quality reduces the repeat repairs and helps us retain the most customers.

Understanding the systemic differences of investments in quality, reliability and discovery allows to design a mix of countermeasures that result in a short-term payoff and provide for a long-term fundamental reduction in repairs necessary.