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A Written Example of ΔT

Compiled by the *CQM Journal* editorial staff

In CQM courses and materials through 1998, there was very little on cycle time reduction except an example of the method from Digital known as ΔT included in Day 6 of the CQM's "6 Day Course." However, even for ΔT there has been no substantial CQM description of the method. This note is intended to partially correct that lapse.

ΔT (standing for actual-delta-theoretical) was invented at Digital's Colorado Springs manufacturing plant in the late 1980s or early 1990s. (We are unsure of the name of the person or people who developed or named the method.) Digital promoted ΔT to other parts of Digital and to other companies. In fact, Digital trademarked it.

Digital described cycle time reduction and the ΔT method as "a structured approach to review all implementation times against the theoretical optimum — the basis of elimination of all wasted time." This definition uses a fairly pragmatic meaning of the word "theoretical." It means the "calculated optimum" based on analysis of the current (or actual) situation; hence the name ΔT .

Digital's ΔT four-step process was:

1. Describe the actual process.
2. Identify the theoretical.
3. Analyze and eliminate the difference (or Δ) between the actual and the theoretical.
4. Challenge the theoretical (that is cycle back to step 1 with the theoretical as the new actual).

Step 1 includes flowcharting the existing process, with each person analyzing his or her own job (and others looking from higher levels to make sure they eliminate unnecessary processes). At step 2 people think about which steps in the process are unnecessary and how long the remaining steps should take if everything goes smoothly. At step 3 they modify their processes. With their newfound experience, they begin again and reanalyze what the theoretical optimum should be.

An example of ΔT follows.

Suppose for instance a company is considering how it might reduce the cycle time of its typical process for employees travel expense reimbursement.

As shown in Chart 1, we first list the current *actual* process that is similar to what many companies use ("you" is the customer in this case). Second, we list the *average elapsed time* for each step of the current process. Notice that we are describing the real process that includes delays, having to talk to people personally, and so forth — not the process as stated succinctly in a policies and procedures manual. (Take a minute or two to look over Chart 1.)

Chart 1 is an example of ΔT as it might appear on a flip chart during an improvement team meeting.

1. You begin to enumerate what you spent, by organizing your receipts and expense notes for entry onto expense report flying home on the airplane Friday, form **[1 hour]**.
 - You sort the envelope of receipts by expense report category.
 - You make hand written notes on hotel receipts of which expenses are for lodging, meals, phone and fax, and other expense report categories.
 - You find currency conversion receipts for each currency conversion in each country visited. Do some sort of rough calculation of what the exchange rate is for cash expenses in each country visited (factoring in conversion fees, bits of change that couldn't be converted and were put into a Red Cross box in an airport departure lounge, etc.)
 - Using a pocket calculator, you convert all the cash charges in foreign currencies to dollars and note the dollar amounts on the receipts or notes about cash expenses.
 - You note which expenditures in foreign currency were charged to credit cards and therefore the actual conversion rate will not be known until the charges get to the credit card company.
 - You carefully save all of the above sorting and notes for later use.
2. Get home **[4 hours]**.
3. Upon arriving home, you put the last receipt, for the taxi home, in the envelope with the rest **[3 seconds]**.
4. You wait a week or more for the foreign charges be processed through to the credit card company, e.g., AMEX **[7 days]**.
5. You phone AMEX and tell them the different charges that were made, giving them country, service establishment name and amount in the foreign currency of each charge **[2 minutes]**.
6. You try to remember when asked whose name the company AMEX account is in before they will tell you anything about the account **[15 seconds]**.
7. AMEX tells you the exchange rate for all but one of the charges, which hasn't cleared yet **[3 minutes]**.
8. You wait three more days **[3 days]**.
9. You call AMEX again, and get the exchange rate this time for the remaining transaction **[5 minutes]**.
10. You get expense form from department forms rack **[1 minute]**.
11. You fill in the expense report by date, by expense category and in dollars, add it up with pocket calculator, staple receipts to form, and sign form **[15 minutes]**.
12. Submit the form by putting it in inbox of department financial analyst **[1 minute]**.
13. Wait to hear from financial analyst **[3 days]**.
14. Analyst arrives in your office to question the detailed reasons for some of the charges, to be better able to attribute them to expense codes; no other problems this time — no argument about expenses being too high. **[10 minutes]**
15. Financial analyst signs expense report and puts it in inbox of department manager **[2 minutes]**.
16. Wait for department manager get around to reviewing expense form, perhaps including coming back from a business trip **[2 days]**.
17. Department manager sits with assistant signs all the documents as fast as possible, including your form **[15 minutes]**.
18. The manager's assistant puts the expense report in the interoffice mail to the accounting department **[2 minutes]**.
19. Envelope travels through interoffice mail system and arrives in inbox of accounting secretary who delivers it later in the day to the inbox of the person now handling travel expense reports **[1 day]**.
20. Wait until the accounting clerk gets to processing this envelope from the inbox **[1 day]**.
21. Accounting clerk notes that the department financial analyst who signed the report is one who sometimes makes mistakes and rechecks the arithmetic **[10 minutes]**.
22. Accounting clerk initials the expense report and fills out an on-line check request form on the IS system coded to the correct department account and expense category **[2 minutes]**.
23. Electronic check request form sits in on-line database until twice monthly check run **[7 days]**.
24. IS system prints check **[1 second]**.
25. Check sits in a pile with other checks waiting to be stuffed into an envelope **[2 hours]**.
26. Accounting clerk stuffs the check in a envelope and puts it in outbox **[10 seconds]**.
27. Envelope travels through interoffice mail system **[1 day]**.
28. Envelope sits in inbox of department secretary **[2 hours]**.
29. Department secretary delivers envelope on your office chair **[2 minutes]**.
30. You take check home and put it on your desk **[4 hours]**.
31. Check sits until Saturday morning you put the check in an envelope to your bank with a deposit slip, and you mail it Saturday afternoon **[2.5 days]**.
32. Check travels through US mail to bank that receives the envelope Monday **[2 days]**.
33. Tuesday the deposit is credited to your account **[1 day]**.

The above totals something approaching 35 days, which is probably not completely atypical. Certainly 15 days would not be surprising for many businesses.

Now let's note the value-added steps — steps that are of concern to the ultimate user or customer — from the point of view of the traveler.

- Step 1.** Enumerate what was spent, while flying home on the airplane Friday.
- Step 2.** Get home.
- Step 3.** Upon arriving home, include the final entry for the taxi fare home.
- Step 12.** Submit for reimbursement to company.
- Step 33.** Deposit is credited to your bank account.

On the flipchart of Chart 1 we would circle the “value-added” steps.

Once we look at the process in terms of these steps that are of value to the end user (in fact, as one enumerates the steps of the existing process), opportunities for “reengineering” the process become apparent. For instance, the process could be reengineered so the above five value-added steps that the customer cares about can be done very quickly from the point of view of the customer:

- The company could put the expense form on-line in a software package that could be installed in the traveler's laptop computer that he or she carries along on the plane. This on-line package accepts expense amounts in all common currencies. Thus, the traveler can just type the expenses into an on-line form on the airplane without worrying about currency conversions.
- The employee can dial up the company employee-only Web site from home (or the plane) and upload the trip report form.
- The IS system looks up the historical exchange rates by date for cash and charged expenses (including an error factor to account for extra expenses and losses during currency exchange).
- The IS system estimates the reimbursement amount in dollars, and tells the on-line user it will be transferring that amount to the user's bank account immediately. From the point of view of the customer, the process is essentially over.
- After the fact, the following steps are carried out:
 - a. The IS system types up a fully organized and categorized travel report and forwards it to the department financial analyst (for any further checks and coding the department desires).
 - b. The traveler gives the division financial analyst an envelope full of receipts and notes.
 - c. If the IS system or the financial analyst notices anything unusual, there is follow up on an exception basis.

Here then are the *theoretical* times for the five steps that the traveler actually cares about:

- Step 1.** Enumerate what was spent to the trip report software, while flying home on the airplane Friday [**45 minutes**].
- Step 2.** Get home [**4 hours**].
- Step 3.** Upon arriving home, include the final on-line entry for the taxi fare home [**5 minutes**].
- Step 12.** Submit the on-line form for reimbursement to company IS system, including whatever dialog is necessary with the IS system [**10 minutes**].
- Step 33** Deposit is credited to your bank account [**1 minute plus 1 day for bank to recognize it**].

By “non-value-added” work, Digital meant work that is not of concern to the final user or customer. For instance, asking for reimbursement for travel expenses, the employee who traveled (the customer) just wants to submit a list of expenses and get back cash or a check. This is “value added” work by the Digital definition. They did not mean to suggest that people doing other steps in this process that are important to the company are without value. For instance, a financial analyst often checks over expense reports and the travelers' supervisors often have to sign them. By Digital's definition (and for the purposes of the AΔT method) that is non-value-added work. However, it is work that is of value to the company and an employee doing such assigned work should feel no decrease in self-worth. (Thus, when actually using this method, companies should perhaps find a different name for “non-value-added” work.)

Total time is 1.25 days. Thus the ratio of the actual for the current system to the theoretically possible is 28 — there is 2800% “non value added” activity that can *potentially* be removed.

Our typical manual systems (particularly those with multiple routine checks and balances) have lots of room for speed-up, as should be clear from the above example. You may not be able to get all that speed-up, and you may not save much of that time for other work. For instance, you may decide you want to keep some of the “non-value-added” steps, and you may not be able to coordinate actions so perfectly that all delays are eliminated. Nonetheless, the reductions in cycle time you can make tend to have a disproportionate gain (since unnecessary steps and delays tend to have multiplicative repercussions as activities increasingly get in each others’ way). The non-value-added work highlighted by the AΔT process is a good place to begin looking for activities and delays that might be eliminated.

Acknowledgement

Yogesh Parikh, for many years with CQM founding member Digital Equipment Corporation, and now with CQM member Mercury Computer Systems, introduced CQM to the AΔT method in about 1991 or 1992; he also briefed us on AΔT’s history.





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