BALANCING PROJECT COSTS AND REVENUE TARGETS

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The search for ways to stabilize the highway financial planning process is meeting with only limited success. Some of the reasons for this are national inflation, environmental complaints, and a strong desire for public involvement in the highway program. One approach being tried by the California Department of Public Works is to deal with change as inevitable and then to look for faster methods of responding to change. A technique has been developed, using a computer with video display terminals, for balancing project costs and revenue targets. The remote terminals, linked by telephone lines to a central computer, enable engineers to retrieve construction and right-of-way estimates from a data bank. Each project cost estimate can be displayed on a video screen, apportioned among fiscal years of expenditure, advanced or delayed to different fiscal years, escalated or de-escalated, and resummarized for balancing against revenue targets. This technique greatly reduces the time-consuming work of balancing and refining a long-range highway financial plan under pressure of frequent change.

•HIGHWAY planning is not the same animal it was 10 years ago. The financial end of highway planning has been especially vulnerable to the changes taking place in our society.

For instance, the combined highway cost escalation rate in California is about 10 percent compounded annually. The combined rate refers to inflated construction and right-of-way costs, plus the effect of improved safety, environmental, and service standards. This means that a $5 million project being planned in 1970 becomes a $15 million project when built in 1980.

Inflation is not the only problem. There are changing public values that work against an orderly long-range plan. There are frequent changes in available funds; there are environmental complaints against highway construction; and there are strong desires for public involvement. All of these factors make it difficult to decide which projects should be built first and in what years they should be funded.

The California Department of Public Works finds itself constantly reshuffling the deck trying to maintain a balance between cost and revenue. The conviction grows that searching for ways to stabilize a long-range plan is no longer a productive effort. Instead, why not look for better and quicker ways to respond to change? With this thought in mind, California has undertaken the development of a planning and monitoring system that includes the use of video display terminals for balancing project costs and revenue targets. Operation of the system is described here.

REVIEW OF HIGHWAY FINANCIAL PLANNING

One of the initial steps in California's highway financial planning process is the annual preparation of a 10-year revenue forecast. Money from the forecast is divided among 11 highway districts, primarily by statutory formula. District Engineers have differing needs and will apportion their share of the revenue estimate accordingly. One District Engineer may need to emphasize freeway operations, another spot improvements, and still another resurfacing. There are fixed costs to be set aside, as well,

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for such things as maintenance, administration, and engineering. When all these essential costs have been skimmed off the top, the remaining money is an expenditure target for major construction and right-of-way.

A long-range plan, called a Multiyear Planning Program, is developed following the revenue estimates. This Multiyear Planning Program includes all major highway projects to be built during the next 10-year period. Major projects are generally those in excess of $500,000 construction costs, although projects between $100,000 and $500,000 are included if they are within 3 years of bid opening.

A Multiyear Planning Program is assembled separately for each of the 11 highway districts. Every project selected for inclusion in the Multiyear Program must have a current cost estimate that includes the construction cost at today's prices and the right-of-way cost at today's market value.

An escalated cost is computed by pumping up the value of the current cost to the years where bids would be opened or right-of-way acquired. The escalated cost of every single project must be spread among the appropriate years when the money will be spent. Construction cost might be spread over 3 years, while right-of-way could be spread over 5 or more years.

Finally, the escalated costs of all projects in the Multiyear Program must be summarized and balanced against the revenue targets for each of the 10 years. That is, the sum of all project costs in a given year must equal the revenue target for that year.

Balancing project costs and revenue targets is a cut and try process. Projects are advanced or delayed with each cut until the sum of project costs approximates the available funds targeted for each of the 10 years. There are about 2,400 projects among the 11 districts, with each district balanced separately against its own target.

The task of balancing would be relatively simple were it not for changes and constraints. Frequent changes cause the long-range plan to undergo constant revision. For every project delayed, because of an environmental complaint or stalled negotiations with a local agency, some other project has to be advanced. When this occurs, it is necessary to rebalance the program, but always within the constraints of mandatory apportionment formulas and Interstate deadlines.

The highway financial planner longs to return to the slower pace of a decade ago unless he belongs to the generation that accepts frequent change as a way of life.

The Need for Fast Response

Because the highway transportation picture is changing so rapidly, any kind of a stable program of project selection and funding is virtually impossible to achieve. Still, decisions must be made, budgets must be prepared, and contracts must be awarded as federal and state moneys become available. There is no apparent way to slow down the rate of change because too many external factors (uncontrollable by highway organizations) are making their influence felt.

A substitute for slowing the rate of change would be to speed up the response to change. In either case, the same end result is achieved if rational decisions can be made about where the highway dollars and the man-hours should be spent.

COMPUTER-DRIVEN DISPLAY SYSTEM

There is a growing interest in the use of video computer terminals that permit data entry and display on a remote cathode-ray tube joined to a central computer by cable or telephone line.

A video display terminal (Fig. 1) works somewhat like a typewriter. The keyboards are nearly identical. On a typewriter, the space bar moves the carriage. On a display terminal, the space bar positions a cursor horizontally to indicate where the next character will appear. Separate keys position the cursor vertically. Corrections are easier than with a typewriter. A character is replaced by simply overprinting with a new character. A SEND key causes all data displayed on the screen to be sent to the computer.

The chief advantage of a video terminal is fast response time. Data can be entered, stored, retrieved, and summarized in seconds. With this kind of fast response, an

engineer can balance and rebalance project costs against targets without feeling overwhelmed by the frequency of change.

The video display system developed by the California Department of Public Works for balancing project costs retrieves its data from a project data bank stored on direct-access computer files. Information on more than 6,000 projects resides in the data bank. It is used for other purposes besides balancing costs and assembling a multi-year highway planning program. It is, for example, the source of a monthly report to management on the developmental status of all highway projects. It is also the source of a quarterly report to the Federal Highway Administration concerning the status of traffic safety projects.

The video display system, developed expressly for balancing project costs, selects all projects for display that meet the criteria for inclusion in the Multiyear (10-year) Program. Projects selected for display are first retrieved from the data bank and collected in a separate computer data file. Only project descriptions, escalation rates, and cost estimates are displayed, although other data such as accident rates, geometry, and traffic volumes are stored in the data file for use on printed reports.

A project is retrieved and displayed by typing in a request at the video terminal. The requester can specify several different "screen formats" described below.

Screen Formats

Three screen formats are available: the Project Data Screen, the County Summary Screen, and the District Summary Screen. They are shown in Figures 2, 3, 5, and 6.

Variations of the Project Data Screen can be displayed depending on whether a project is funded with all Interstate money, all non-Interstate money, or a combination of both (Figs. 2 and 3).

Each data element on a typical Project Data Screen is shown labeled in Figure 4. All data elements can be updated on the screen except the project identification.

The County Summary Screen is a "read-only" screen. It summarizes all project costs within the specified county. The District Summary Screen summarizes all project costs within the specified highway district. It is a "read-only" screen with the exception of the target line, which can be updated (Figs. 5 and 6).

DISPLAYING AND BALANCING

All of the following methods for manipulating data at the video terminal apply to both right-of-way and construction dollars.

Project Escalation

Construction cost estimates can be escalated independently of right-of-way cost estimates. The computer reads the given escalation rate and looks up a factor for the appropriate year from a stored table. The factors are derived from a modified compound-interest formula. Construction costs are escalated to the first year of construction while right-of-way costs are escalated to each individual year of expenditure.

New Values Option

New dollar values (in $1,000) can be entered in any fiscal year. The computer will accept these as escalated values, but it will calculate the true escalated total by applying the escalation rate to the current cost. If this is different from the sum of the new values entered, the computed escalated total will be displayed on the message line (Fig. 7). This is defined as an unbalanced condition.

Balance Option

When an unbalanced condition occurs, the display station operator has two choices. He can ignore the unbalance and update the file, or he can balance by placing a B on the appropriate line. This will cause the computer to distribute and display the computed escalated values in the same ratio as the original displayed values. By touching

Figure 1. Display station manufactured by Control Data Corporation.

Figure 2. Project Data Screen: I prefix denotes Interstate project.

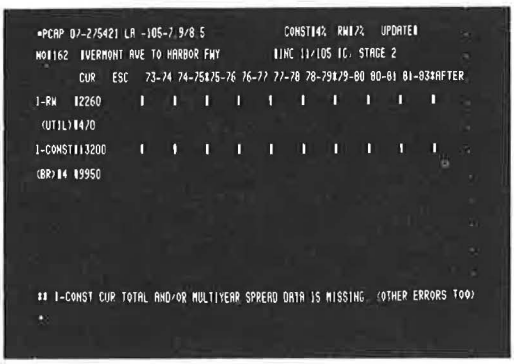


Figure 3. Project Data Screen showing combination Interstate and non-Interstate project.

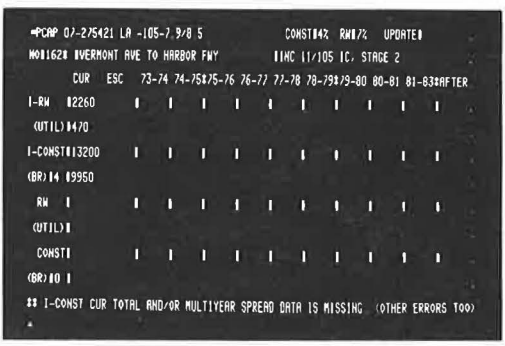


Figure 4. Typical Project Data Screen with labels.

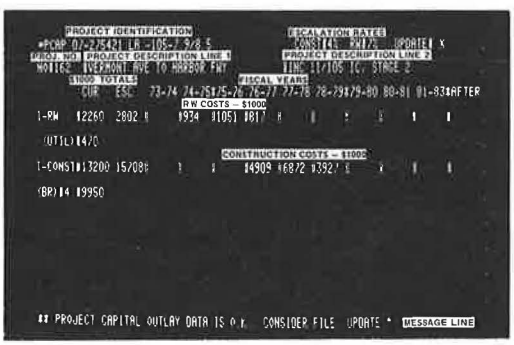
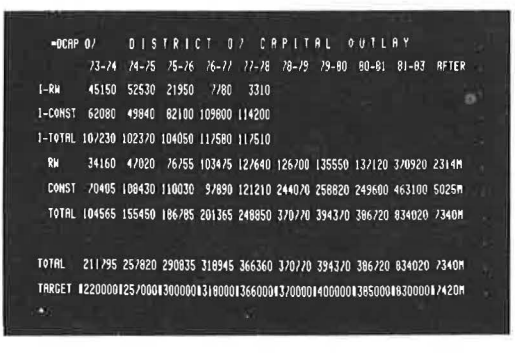


Figure 5. County Summary Screen.

Figure 6. District Summary Screen.



the SEND key on the keyboard, this happens literally in the blink of an eye (Figs. 7 and 8).

Updating the File

As a precautionary measure, the operator is required to take a positive step to update the video data file. To enter data from the Project Data Screen into the video data file, he must place an X opposite the word UPDATE before touching the SEND key; otherwise the display will be returned without updating. The message line tells him when everything is balanced and ready for update by displaying the message "PROJECT CAPITAL OUTLAY DATA IS OK. CONSIDER FILE UPDATE" (Figs. 8 and 9).

Round Option

Ordinarily, all values are displayed in thousands of dollars. If the operator wants to round construction costs to $10,000, he replaces the % sign next to the escalation rate with an R. This tells the computer to round all construction costs to $10,000 (Fig. 10).

Percent Option

Instead of entering new values, the operator may wish to enter percent values assuming, for example, that a certain percentage of the total right-of-way money will be spent in each of several years. The computer will escalate the current cost, apply the percentages, and display the values. Again, it all happens in the twinkling of an eye (Figs. 11 and 12).

Move Option

Balancing capital outlay costs against revenue targets is a trial-and-error process. Some projects are advanced and others delayed. With each iteration, costs approach the target as a limit. Advancing a project means that the money will be spent in earlier years. Delaying the project means that the money will be spent in later years. If, for instance, the operator wants to delay right-of-way and construction expenditures by 2 years, this is accomplished simply by placing an X in the appropriate year (Fig. 13). By touching the SEND key, all right-of-way and construction values are moved to the right 2 years and escalated (Fig. 14). This change, of course, immediately revises the summaries. The operator can move back and forth between project displays and summaries until he zeros in on the target.

Spillover Option

Under some circumstances, especially where the construction estimate is so large (in excess of $10 million) that payments to contractor extend over a 3-year period, the operator may estimate the amount that would be spent during 2 of the years and ask for the balance to be placed in a third year. He does this by placing the character S in the third year (any designated blank year). The computer will compare the sum of the first 2 years with the escalated total and return a screen with spillover placed in the third year (Figs. 15 and 16).

County Summary Screen

At any time, the operator may display the County Summary Screen (Fig. 5) by changing the display code from PCAP (project capital outlay) to CCAP (county capital outlay) and specifying the county. The County Summary will reflect any changes made on the Project Data Screens.

District Summary Screen

Because highway fund money is allocated by statutory formula to each of 11 geographical districts, the District Summary (Fig. 6) is important. Target values can be entered on this screen for comparisons against totals. The District Summary Screen

Figure 7. New values and balance option: New values entered. Message line indicates construction dollars not in balance. Symbol B causes balancing to occur.

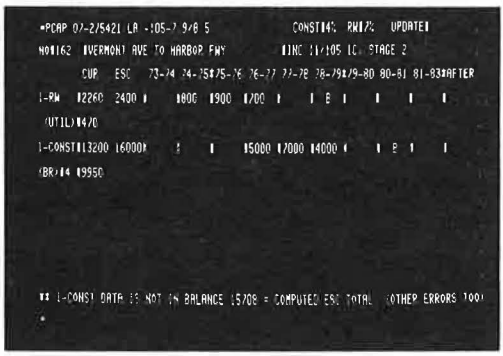


Figure 8. Balance and update options: Balancing has just occurred and operator has placed X in update box ready to update.

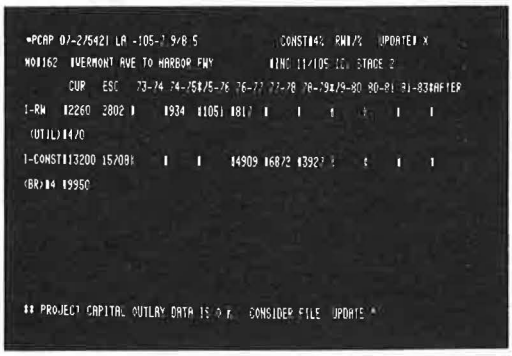


Figure 9. Updating the file: Note message line.

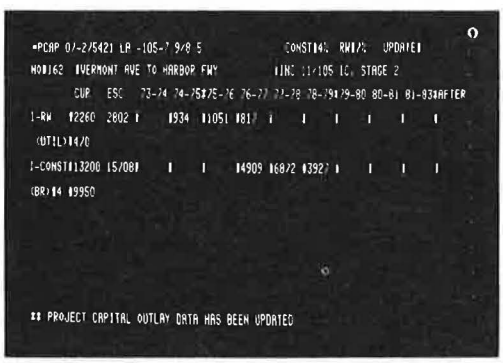


Figure 10. Round option: All dollars rounded to 10,000.

Figure 11. Percent option: Percent values displayed.

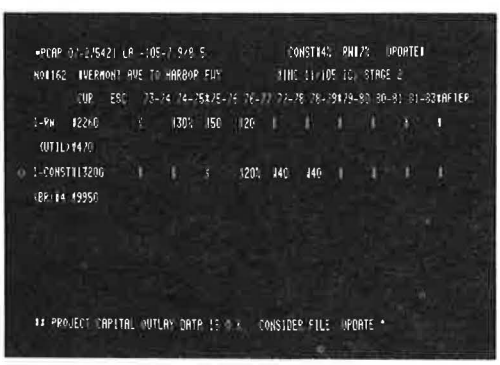


Figure 12. Percent option: Just after percent values applied.

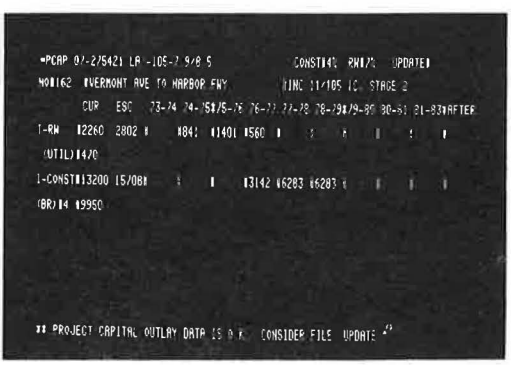


Figure 13. Move option: Operator has just placed X in 78-79 R/W year and 80-81 construction year.

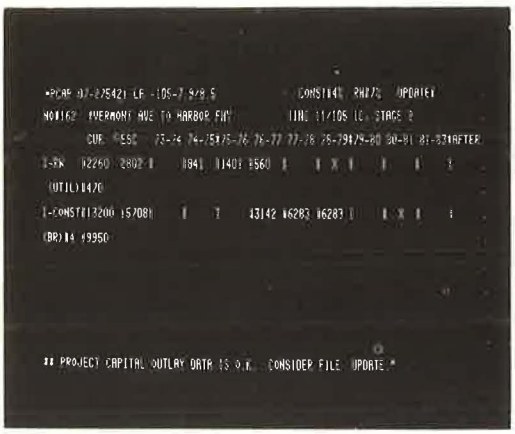


Figure 14. Move option: Dollars have been moved and escalated.

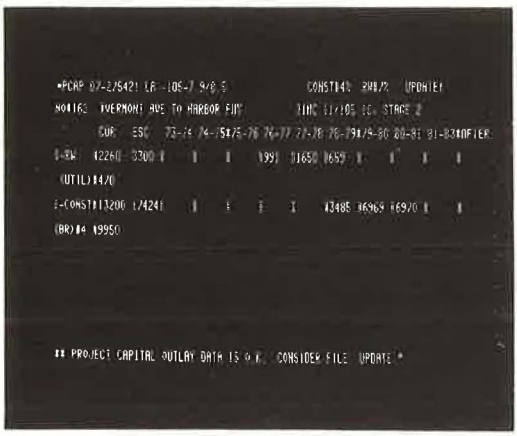


Figure 15. Spillover option: Operator places symbol S in year of his choice.

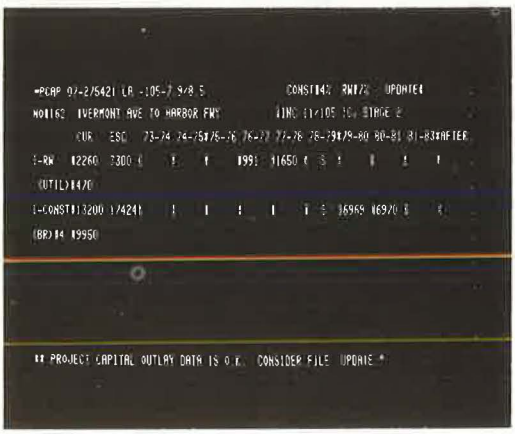
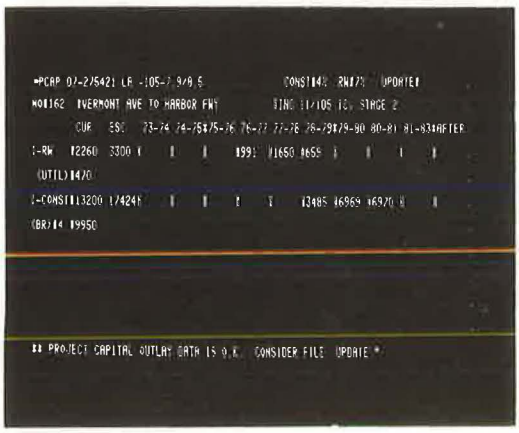


Figure 16. Spillover option: Computer returns screen with balance of computed total placed in S year.



reflects any changes made on the Project Data Screens.

Printed Reports

Any screen display can be printed directly on an electric typewriter connected by cable to the video terminal by simply touching a PRINT key on the video keyboard. This is a convenience for getting quick, hard-copy summaries after making trial balancing runs.

In addition, two formal printed reports can be requested. The first is a list of all projects in the video data file by district, county, and route number. Interstate projects are listed first, followed by non-Interstate projects and finally by a summary.

The second is an individual sheet for each project, which shows, in addition to all the data on the first report, more complete information about each project, such as traffic accident history, geometry, and so forth.

These latter two reports must be printed "off-line." They can be initiated at the video terminal, but they are printed either on the high-speed printer at the central computer or on a medium-speed remote printing terminal located in a district and connected to the central computer by telephone lines.

SUMMARY AND CONCLUSIONS

A technique involving the use of a computer and video display terminals has been developed for balancing highway project costs against revenue targets. The technique is being used in an organization having 2,400 major highway projects in various stages of development. It is successful as a management tool because it offers quick response for decision-making where management operates in an environment of constant change.

Remote video display terminals tied into a central computer give engineers the ability to retrieve from a data bank right-of-way and construction capital outlay estimates and to display them individually by projects and collectively by district or county summaries.

The engineer can enter new values, move capital outlay from one fiscal year to another, escalate values, change escalation rates, resummarize, and initiate printed reports. All of these functions can be done quickly and simply by using a video display terminal with keyboard input.

A year of experience with the system has shown that the time-consuming work of balancing and refining the Multiyear Planning Program under pressure of frequent change is greatly reduced. This is one of the payoffs that helps to offset the rising cost of financial planning for federal and state highway programs.

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