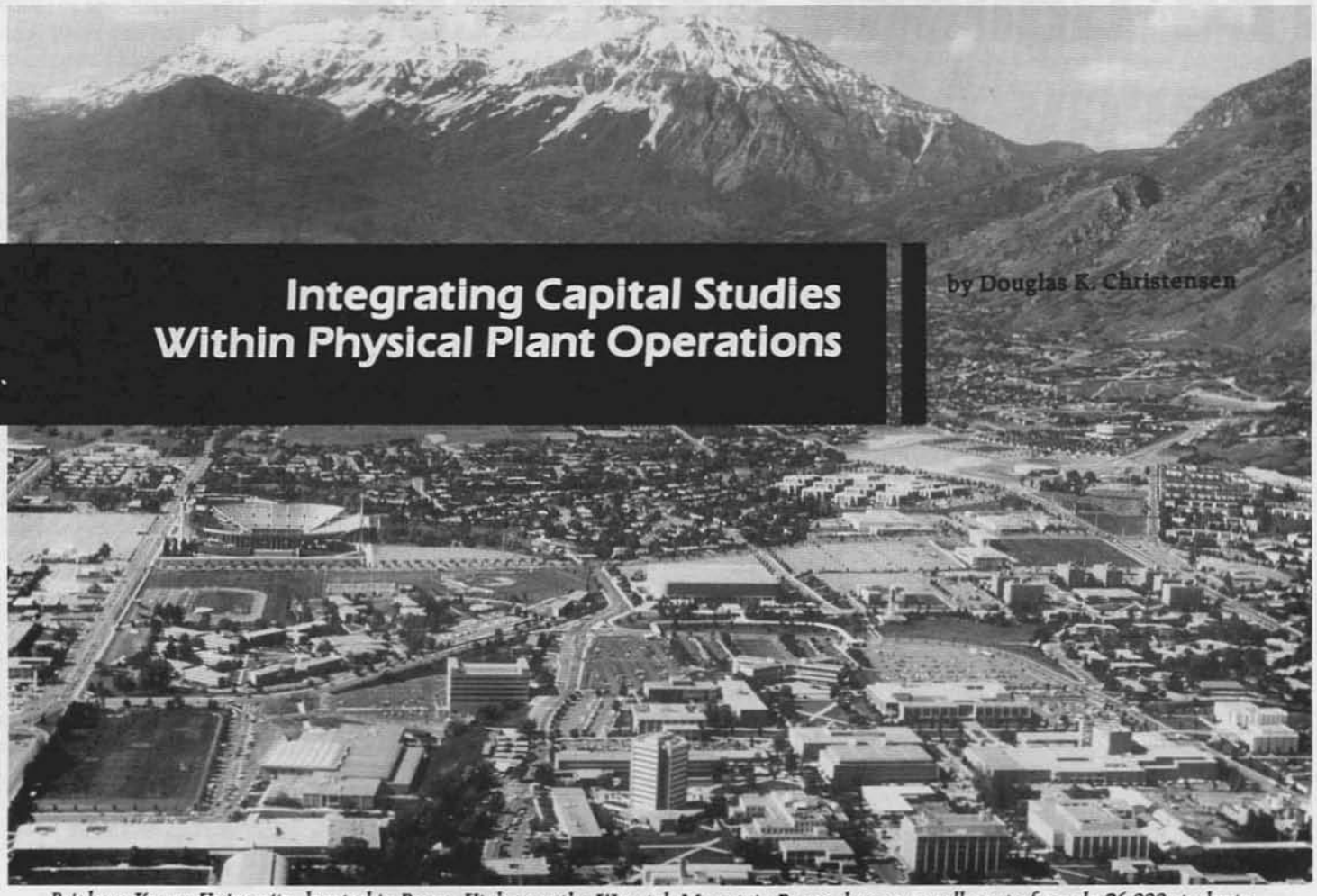
Integrating Capital Studies Within Physical Plant Operations

by Douglas K. Christensen



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Brigham Young University, located in Provo, Utah near the Wasatch Mountain Range, has an enrollment of nearly 26,000 students.

A capital renewal and replacement program can be an important part of the maintenance program. It can provide a continuity of maintenance purpose or it can be a missing link that drastically affects the ongoing maintenance program and resources within an institution. The following is a general review of the principles learned at Brigham Young University (BYU) about managing a total program of integrating capital renewal and replacement concepts within the physical plant operation. These principles have basically been in effect since 1981. The purpose of this article is to share the procedural steps and principles of organization that have been adopted and have improved the way facilities are managed at BYU.

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The Scope

In 1981 a challenge from the Commissioner of Higher Education became the driving force behind the establishment of a capital renewal and replacement program at Brigham Young University. This capital renewal and replacement program is called the Capital Needs Analysis Program (CNA). The scope of the CNA program determined the following: 1) what the capital replacements needs and trends were for the next forty years; 2) how the institution would manage for capital needs given a funding limit each year; 3) how to create an annual, detailed list of *all* capital needs that would be funded and completed that given year; 4) how to incorporate this program within a physical plant operation and deal with the decision of when to repair vs. replace and establish a replacement standard or maximize useful life; and 5) how to establish an ongoing capital needs program to maintain building integrity and usefulness.

Given the challenge above and having the understanding that the first priority in capital funding would be replacements, followed by retrofits and then improvements, we realized there was an emphasis to develop a total capital needs program. Once the scope had been defined, we proceeded to establish what was needed in a study of capital needs on campus.

The Study

A lot of information and detail went into the capital needs study. The proper organization of information and details was the key. All of the information dealing with the study was collected into three computer data bases: the Building/Area File, the Replacement Cycle File, and the One-Time-Only File.

BUILDING/AREA FILE The purposes of the Building/Area File were to describe the buildings and campus areas that were included in the study, and to use this information to verify data entry in the Replacement Cycle and One-Time-Only files. This file assures that all information in the capital program relates to a building or area. Figure A shows the resources and

elements within the Building/Area File.

REPLACEMENT CYCLE FILE This file represents the main file in the study program. It is organized in such a way that includes all replacements for buildings and campus areas (see Figure B). The resources of information for interiors came from floor plans; building exteriors came from building plans; major equipment in buildings and facilities came from equipment inventories; utility and telecommunication systems came from system plans; and general site items came from campus plans. The replacement study consists of two main elements; an *inventory* of all of this replacement information, and an *evaluation* of the inventory.

Inventory Part of the Study As shown in Figure B, the inventory consists of a number of items that relate to the location and classification of the inventory. Defining how far and how much to inventory is a significant part of the study design. Careful consideration as to how much *detail* to incorporate into the study was of the highest concern. We struggled and settled on a level that would give enough information to manage replacements.

There are two key elements that helped to minimize the detail in our study design. First, we chose to collect information by room number, but summarized it by room type. These room types were such things as classrooms, hallways, offices, etc. Within each building we related these room types to a floor. The worst case scenario that we would have to manage would be by room-type by floor. An example: we would not replace carpet in one office, but would consider all of the offices on a single floor within a building. When all of the offices on that floor needed carpet replacements, we would replace *all* of the carpet. There are a number of benefits to the room-type summary. We wanted to take advantage of volume work and be consistent in the type of carpeting and architectural integrity of the offices on a floor. Managing by room-types on a given floor helps to reduce the detail substantially and be consistent in what our approach is to maintaining the integrity of a building.

The second area that we examined to minimize detail closely was our approach to utility systems. Our approach was to identify the major component parts of a system, or those items that have a different life cycle

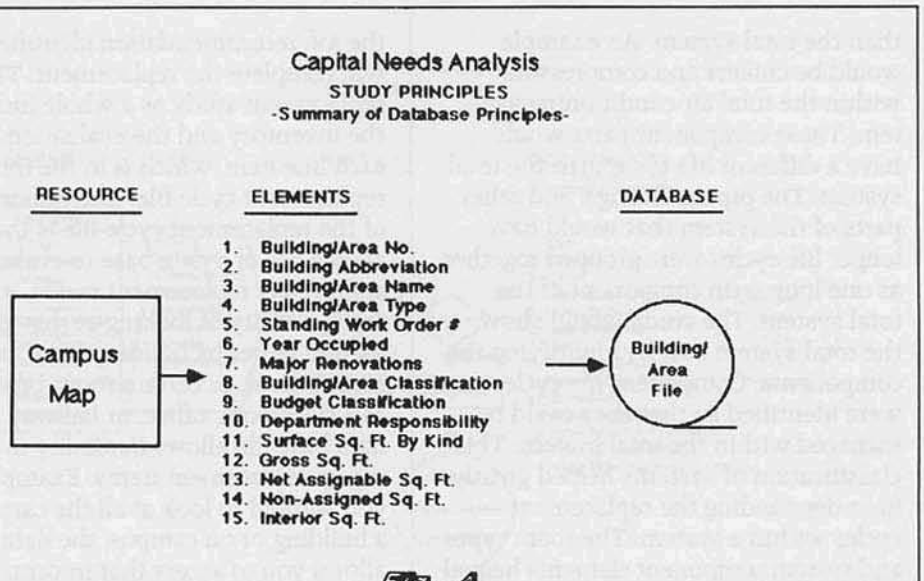

Fig. A

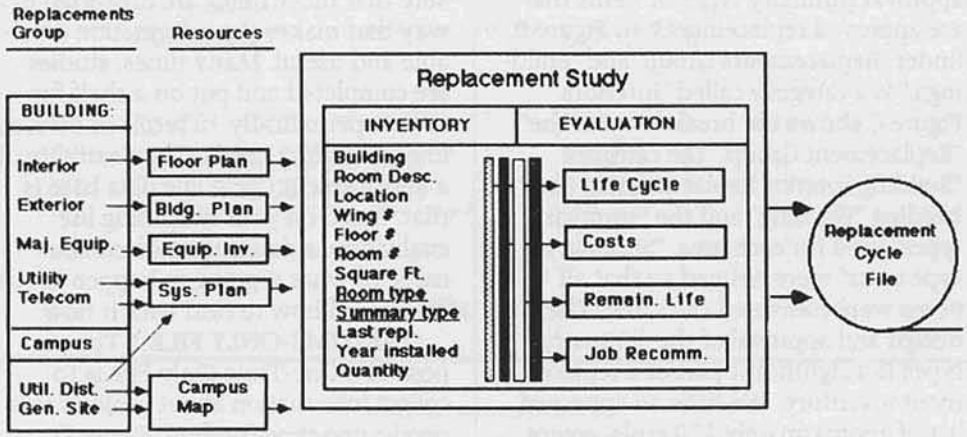

Fig. B

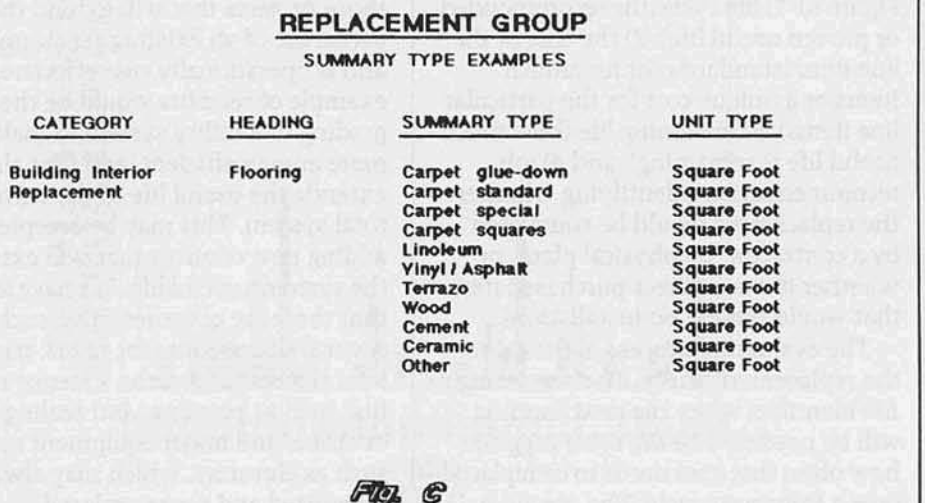

Fig. C

than the total system. An example would be chillers and compressors within the total air-conditioning system. These component parts would have a different life cycle than the total system. The piping, fittings, and other parts of the system that would have longer life cycles were grouped together as one long-term component of the total system. The study would show the total system cost by identifying the components. Component life cycles were identified so that they could be managed within the total system. This classification of systems helped greatly in understanding the replacement cycles within a system. The room types and system component elements helped reduce the detail and confusion dealing with replacements inventory.

The inventory is the key to the replacement study. We chose to have a detailed inventory to allow detailed tracking of items. This was accomplished by a careful establishment of approval summary types or items that are approved replacements. In Figure B, under "Replacements Group" and "Buildings," is a category called "Interiors." Figure C shows the breakdown of the "Replacement Group," the category "Building Interior Replacements," the heading "Flooring" and the "summary types" used for each area. "Summary type units" were defined so that all items were measured the same. The design and approval of the summary types is a significant part of a replacement inventory. We have an approved list of approximately 150 replacement summary types used in the inventory.

Evaluation Part of the Study Once the inventory and line items were identified within each building, we evaluated each line on four points (see Figure B): 1) life cycle (the recommended or proven useful life), 2) the cost of the line item (standard cost for similar items or a unique cost for the particular line items), 3) remaining life (how much useful life is remaining), and 4) job recommendation (identifying whether the replacement would be completed by a contractor, by physical plant, or whether it was a direct-purchased item that would require no installation).

The evaluation process is critical to the replacement study. The *remaining life* identifies when the next funding will be needed. The *life cycle* suggests how often that item needs to be replaced over a forty-year cycle. The *costs* are set at the current replacement cost and the *job recommendation* identifies who will complete the replacement. The replacement study as a whole includes the inventory and the evaluation of each line item, which is in the total replacement cycle file. The importance of the replacement cycle file is that it allows use of a data base to evaluate and project replacement needs. It gives the flexibility of looking at this information either by building, total campus, certain floor, or certain room-type, such as a classroom, office, or hallway. The data base file allows flexibility in looking up replacement items. Example: if you wanted to look at all the carpet in a building or on campus, the data base allows you to access that information. If you are dealing with the replacement of building utilities, you could look up compressors or chillers, roofing, elevators, or lawn sprinkler systems.

The critical part of the Replacement Cycle File is defining what is considered a capital replacement and then making sure that those items are organized in a way that makes the information available and useful. Many times, studies are completed and put on a shelf for review periodically, in terms of bottom-line or funding needs. The flexibility of a Replacement Cycle File data base is that, based on your remaining life evaluation, a determination can be made of what is going to happen in the future and how to deal with it now.

ONE-TIME-ONLY FILE The purpose of a One-Time-Only File is to collect information about projects that need a one-time funding. Figure D describes how we establish a one-time-only file. Under "groups," we have two types that we are dealing with. One is classified as *retrofits*, the other as *improvements.* Retrofits are defined as those projects that will extend the useful life of an existing replacement and is operationally cost effective. An example of retrofits would be the upgrading of a utility system to make it more energy efficient, and that also extends the useful life of the current total system. This may be accepted by adding new controls that will extend the system's useful life. We have learned that there are other retrofits, such as general site retrofits for roads, parking lots, cement, and curbs; exterior retrofits, such as pointing, and sealing brick or stone; and major equipment retrofits such as elevators, which may always be retrofitted and never replaced.

Improvements are classified as One-Time-Only projects and deal with *mandatory/compliance*, which tracks and builds a facility master plan on regulatory issues (i.e., local codes, Handicapped 504, EPA); *general site improvements* (i.e., new roads, new sprinkler systems); *extension of utilities/telecommunications; remodeling* existing space for functional use or change; and *new space* (i.e., additions to the building or new buildings). As needs arise, such as demands, upgrades, and requests, a scope approval is required (see Figure D). Scope approvals at Brigham Young University follow the line responsibility through a department chair, then dean, to a vice president. If the scope of the project is approved, then the next question is funding. If funding is available, then the project is completed and the effects of that project are added to the Replacement Cycle File. If there is no funding, but the scope of the project is such that when funding becomes available, it would be a high priority, then the project is put into the facility master plan.

Figure D notes items listed as part of the facility master plan. These elements allow evaluation of items within the facility master plan; i.e.; items by benefiting college, by building, by priority—either the college level, the vice president level, or the university level. This data base is a great tool in managing requests, whether funded or not. This is an ongoing, day-to-day process. As new items are added, they are evaluated in terms of previous items in the facility master plan, and a priority relationship is established. This makes available a current and complete listing of all scope approval requests and what the status is of each. The facility master plan is an excellent tool in identifying the retrofit and improvement capital needs.

Study Summary It is important to understand that all three of these data base programs relate to each other. With proper information and coordination, the physical plant department can evaluate replacements and one-time-only projects within a building and coordinate and plan better what ought to happen. The additional information learned from the study of capital needs gives Physical Plant a tremendous tool in understanding better what pressures and desires there are for a given facility.

The Information

Due to the way in which the replacement study information is collected,

there are two tools that have been successful in the management of the total capital needs program: the building spreadsheet and projected funding graphs.

The building spreadsheet is strictly a listing of items within a building and the years in which they will be replaced. You will note in our example, in Figure E, that all of the items are grouped as "Replacement-Floor-Carpet/Special" for the Smoot Building. All of the special carpet is listed together by room-type by floor. This information identifies what year similar items are currently due for replacement. The spreadsheet has three purposes: 1) to be able to answer requests and give direction to questions about replacements within a certain building, 2) to assist in planning and evaluating what replacements or one-time-only items are being suggested within a building, and 3) to allow the opportunity to group together replacements if useful lives are close. Example: whenever a ceiling replacement comes up, consideration is given to any utility work that may be in the ceiling, or any light replacements that may be due. It is appropriate to group together similar replacement types by either deferring the ceiling, or bringing the other replacements forward. The important point about building spreadsheets is that they provide a detailed picture of what is happening and what type of items may need to be grouped.

Another use of the building spreadsheets is assisting in our remodeling costs. When we receive a request to do remodeling, we look at the replacement file to see if there are any replacements that need to be considered. In some cases replacements can offset some of the costs of remodeling. It is important to note that we do not automatically replace items because of remodeling. The only time we use the capital replacement funds is if useful life has been expended. This principle is also helpful when we are dealing with a total building renovation. Replacement funding can assist greatly in major renovations of older buildings.

The projected funding graphs use the information from the data base to project a graphic representation of funding for all capital needs. You will note in Figure F that there is a graph being represented. Each graph contains two graphs overlaid. Line A (which is a vertical line and then a horizontal line) represents the first graph. The high

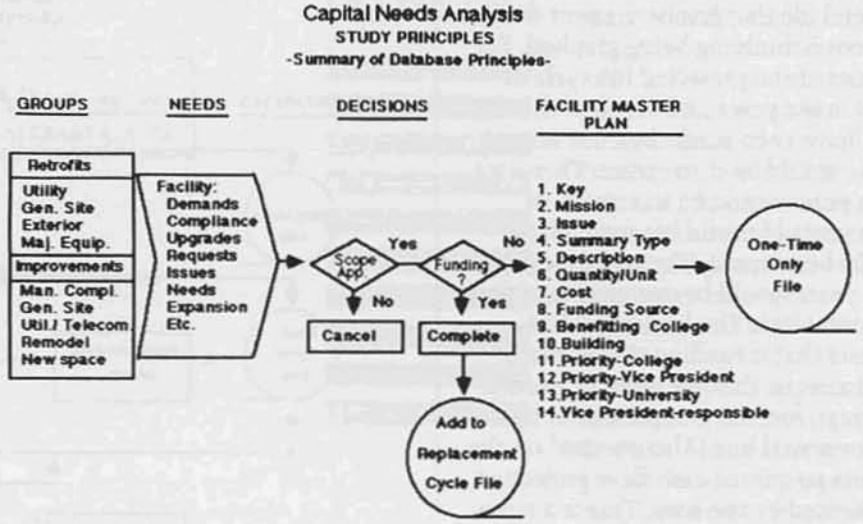

Fig. D

CAPITAL NEEDS ANALYSIS
Brigham Young University - Provo
Cycle File -- Spreadsheets
by Building by Summary Code

ASB SMOOT (ABRAHAM O) BASE YEAR: 1985

CYCLE. FILE	SUMM CODE	Summary Code Description	ROOM TYPE	FLR	WING	TOTAL COST	LIFE CYC	REM LIFE	BASE 00000 12345	YEAR 00001 67890	PLUS 11111 12345
1* 19321	1032	REPL-FLOOR-CARPET STND	UNASSIGNED	3	A	$303.80	10	3	•		•
	***										
1* 15466	1033	REPL-FLOOR-CARPET SPEC	CONFERENCE	2		$1,515.00	10	7		•	
1* 14787	1033	REPL-FLOOR-CARPET SPEC	OFFICES	2	A	$6,816.00	10	3	•		
1* 14792	1033	REPL-FLOOR-CARPET SPEC	OFFICES	2	B	$ 765.00	10	6		•	
1* 15484	1033	REPL-FLOOR-CARPET SPEC	OFFICES	3	A	$ 627.00	10	1	•		•
1* 14355	1033	REPL-FLOOR-CARPET SPEC	SUITE/GPD RMS	2	A	$3,981.00	10	3	•		•
	***					$13,704.00					
1* 16243	1036	REPL-FLOOR-VINYL/ASPHALT	CIRCULATION	0	A	$2,538.00	30	8		•	

Fig. E

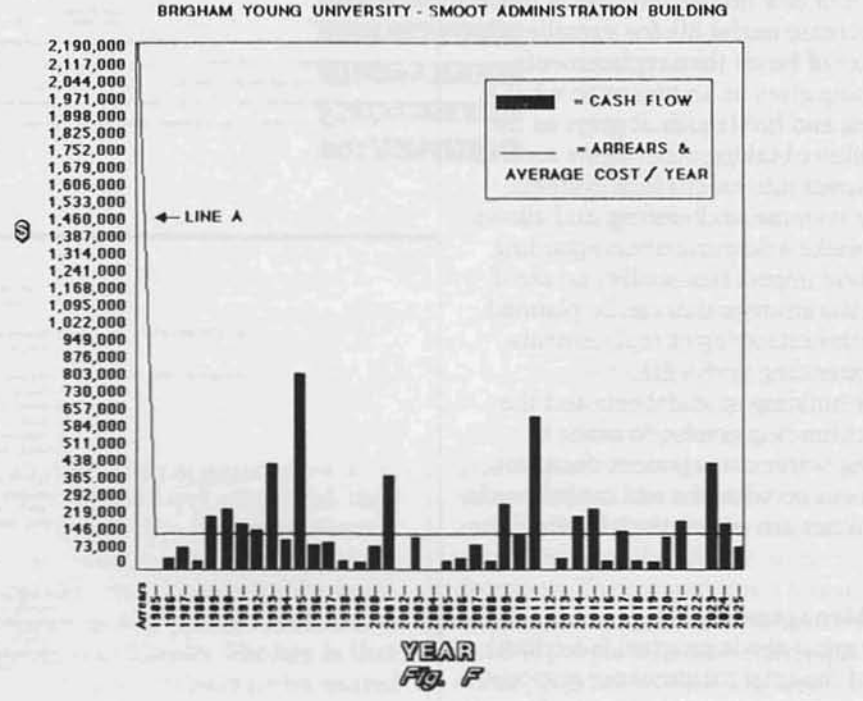

Fig. F

point represents the amount of arrears or useful life that has been spent within the item or building being graphed. For instance, if the projected life cycle of carpet is ten years and seven of those years have been used, then our remaining life would be three years. Therefore, seven years would be in arrears, or seven years of useful life would have already been spent. The remaining three years would be averaged into that horizontal line. The horizontal line suggests that if funding was available for all arrears, that the amount needed each year, forever, is represented by the horizontal line. Also overlaid on the graph is an annual cash flow projection, represented by the bars. This is a representation of the summary of all items with remaining life equal to the year illustrated in Figure F. There are two graphs imposed, one on the other. This gives management a look at the annual cash flow or the arrears and ongoing costs to meet replacement needs. The information can be summarized and graphed by Physical Plant and represents all of the facilities that are assigned to the department. We can graph revenue areas on campus, who may have building responsibility, to show what their replacement needs are. We can graph a total campus and summarize all facilities on campus.

One item to notice in the graph is the cash flow spikes. Since each point on the graph is represented by detail, we can analyze the increased cost. Many times we are able to suggest retrofit or one-time-only projects that can increase useful life for a smaller amount of funds than replacements. Graphing gives us an idea as to what is coming and how much. It gives us the capability of taking other items such as floor coverings, mechanical systems, utility systems, and roofing, and allows us to make a determination regarding its future impact financially and see if there is a strategy that can be planned for better managing of replacements and extending useful life.

The building spreadsheets and the project funding graphs do assist in making better management decisions and focus on what the real capital needs of facilities are within the physical plant.

The Management

A capital needs program is a critical part of the total maintenance responsibility. It merges the information from a

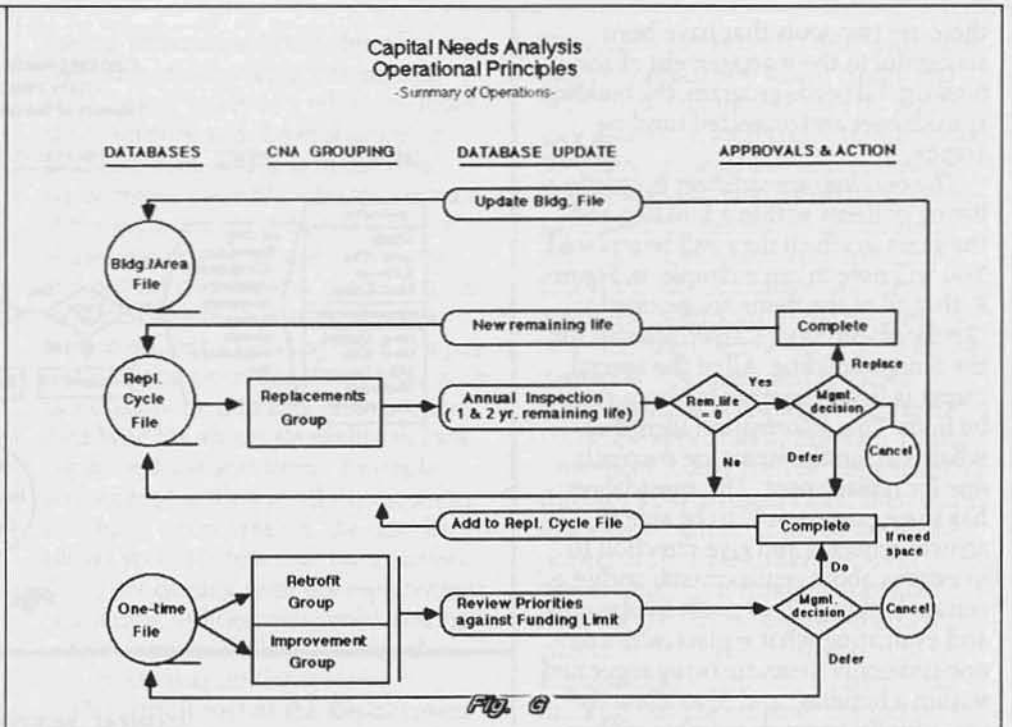

Fig. G

(inspection.form)

CAPITAL NEEDS ANALYSIS - REPLACEMENT INSPECTION - DETAIL REPORT
BYU 1986-1987

00 JAN 1986
Return by 14 February 1986

Category Leaders Decision: ____fund ____defer ____cancel
Category : BUILDING INTERIOR REPLACEMENT
Category Leader: SHOELL, L.
Inspector : PAULSON, J.

Key: 1*18536 Description: 1032 REPL-FLOOR-CARPET/STANDARD
Building: SMOOT (ABRAHAM O) ADMINISTRATION BUILING Floor: 2 0 Room Type: SUITE/GROUPED ROOMS
Quantity: 1881 Sq.Ft. Year Installed: _____ Location: _____ Job Rec: Physical Facilities
Room Number(s): 0206, 0208, 0227, 0238, 0238A, 0240B, 0246, 0256, 0257, 0257A, 0257B, 0257C, 0257D, 0268

INSPECTION INFORMATION

Estimated Remaining Life (yrs) ____ or Cancel from study ____

NOTE: If Remaining Life IS NOT ZERO, go to next inspection.
If Remaining Life IS ZERO, complete ALL of the following information.

A. Can it be repaired? ____yes ____no
Labor cost $_____
Material Cost $_____
Repair cost $_____
Remaining life after repairs (yrs)$_____
Repair cost/year $_____

B. Is a similar replacement needed? ____yes ____no
Labor cost $_____
Material cost $_____
Replace cost $_____
Life of new item (yrs) $_____
Replacement cost/year $_____

C. Is an up-grade needed? ____yes ____no
Labor cost $_____
Material cost$_____
Up-grade cost$_____
Life of up-grade item (yrs)___
Up-grade cost/year $_____
Estimated savings/year $_____
pay back (yrs) _____
Technical upgrade? ____yes ____no
Other:_____

D. Importance (choose one): ____Life or Property threatening? ____Functional Need? ____Cosmetic Need?
E. Consequence if not done: _____
F. Cost information provided by: _____ Attach specification for basing cost estimates.
G. Job recommendation (check all that apply): ____Physical Facilities ____Auxiliary Maintenance ____Contract ____Purchase only
H. Inspectors and Category Leaders priority: ____do early ____high priority ____needed
I. Inspected by: _____
J. Notes:

Fig. H

CAPITAL NEEDS ANALYSIS
- MANAGEMENT GOALS -

BUILDING AREA FILE
1. Updated and complete listing of buildings and areas
2. Provide information consistency within files

REPLACEMENT CYCLE FILE
1. Flexibility to defer funding to maximize useful life
2. Inspections provide management information for decisions
3. Inspections information updates file information
4. Track actual life cycles to determine long-lasting replacements
5. Inspector and management determine replacement standards
6. Answer questions and requests about replacement timing

ONE-TIME-ONLY FILE
1. Only fund top priorities given limited resources
2. On-going process of listing needs and evaluating them against previous needs vs once a year wish list
3. When completed: (1) Update replacement cycle file with new items
(2) Update building area file if new space

OVERALL
1. Coordinate replacements with one-time-only projects
2. Manage better all capital needs within the university
3. Maintain total building and campus integrity
4. Computer tracks information--people use information to manage better
5. To provide a on-going long-range capital plan

Fig. I

capital needs study and integrates within a physical plant operation. One of the keys in managing a capital needs program is to have the flexibility to do what has to be done, when it has to be done. To allow for flexibility, three decisions are important:

1. *Fund*—flexibility to fund an item that is the highest priority where useful life has been maximized.
2. *Defer*—flexibility to defer projects with funding. The program needs flexibility so that the funding is coherent with expended useful life. The defer concept allows us to maximize useful life by deferring replacements if replacement is not needed, or to bring forward any items that may have been misjudged in terms of remaining life. The position of having to spend money causes poor management decisions.
3. *Cancel*—the decision; canceling an item helps keep the needs better in focus. Having the flexibility to fund, defer, or cancel any line item in the study data base gives management the flexibility to determine exactly what the real funding needs ought to be.

From the operational point of view, there are two files that need annual review and updating (see Figure G): 1) the replacement cycle file/replacements group items, and 2) the one-time-only/retrofit and improvement group items.

Replacement Cycle File The replacement cycle file items are updated as part of an annual inspection program. Each year an inspection consists of those items with one- and two-year remaining life. An inspector looks at those line items and suggests the actual remaining life. If the remaining life is zero, then the items are sent to management with a recommendation to replace, cancel, or defer the item. If the remaining life is greater than zero, meaning we still have additional useful life, the item is updated and put back into the data base to be brought up for another inspection. Management always has the option, after receiving the information from the inspector, to defer the item again. If management chooses to complete the item, then the life cycle year is put in the new remaining life field within the replacement cycle file data base.

Employees from the maintenance shops are the inspectors and provide management with information based from a maintenance point of view. In some cases experts are needed to help determine remaining useful life, such as in electronics or major mechanical systems. The great advantage to shops doing the inspections is the tying together of all maintenance information. We have learned that as management and inspectors work together a standard for replacements can be agreed upon.

A simple example: the inspector suggests a replacement of carpet. Management and the inspector together can determine the level of repair or when to consider a replacement. This combined effort has helped immensely in identifying the repair replacement standard for capital items. This approach is a significant part of the team building that has happened as a result of the inspection process. As replacements take place, the actual life cycle is stored for reference and used to evaluate future life-cycle replacements. We have noted that in almost every case we clearly exceed the recommended life cycle if proper maintenance has taken place. Figure H is an example of the inspection form used. Special note should be taken to parts A, B, and C of the inspection form. The information needed to assist management in making a better decision is to know the total cost (labor and materials), the estimate of remaining life, and the cost-per-year given the repairs, replacements, or upgrade. This isn't to say that the final decision results are made because of parts A, B, and C; but it does give additional information in making better management decisions. In many cases, the major repair of an item rather than replacing it is the most economical thing to do. The remaining part of the inspection information also assists management in decision making.

One-Time-Only File You will note in Figure G that the one-time-only file/retrofits and improvement groups are reviewed by priority against funding limits. As capital funding becomes available, the management and administration make final decisions as to when the one-time-only projects should be completed, cancelled, or deferred. If the item is deferred, it remains in the one-time-only file for further review. If the item is funded and completed, then its effect is added to the replacement cycle file. If the one-time-only project is dealing with new space, then the building/area file is also updated with the additional information. The key is that *all* one-time-only projects are evaluated as to their effect on the building/area file and the replacement cycle file.

Figure I represents the management goals, which have been established for each of the files and overall program within the capital needs program. The real success of managing the capital needs program has been our ability to take *the study, the information,* and *the adjustments* in the data bases each year (inspections and priorities) and have the flexibility to manage in a meaningful and practical way.

Summary

There are many ways to approach a capital renewal and replacement program. In this article I have attempted to identify the procedures and program at Brigham Young University. Hopefully, this information will stimulate ideas and thinking about a total capital needs program. The major success at BYU is the great administrative and financial support, as well as the overall concern shown for facilities and maintenance.

We received a scope and mission of what we needed to accomplish. We organized a study that included an inventory and an evaluation of that inventory. It assisted us to better manage our replacement items. From the study we were able to share with management specific information about capital needs. We were then able to incorporate within the physical plant operation a capital review program using inspections to update replacements and priority review to update one-time-only requests. The management flexibility of the program helped us learn what information was needed to make good, solid management decisions and maximize the useful life of replacement items.

The integrity and credibility of the program has gone a long way in establishing a trust and support for the program. As complicated as this may seem, it is actually a simple process. The use of computers has made it easier because of the mountains of information that are needed to make decisions. Probably the one aspect of the program that is critical and needs to be emphasized is that it is a *people-governed* system. The inspection process, the management decision, the information process, and the flexibility of deferring decisions to maximize useful life are all *people* decisions. The computer is a tool and enables us to organize the information, but it is people who make the capital needs program work at Brigham Young University. ■