A LIFE-CYCLE COST ANALYSIS

FOR

FLOOR COVERINGS IN SCHOOL FACILITIES

Prepared March, 2002, by:

Jeff Bishop, Certification Board Chairman
Institute of Inspection, Cleaning and Restoration Certification, Vancouver, WA

Data source:

Building Office Managers Association (BOMA)
Carpax Associates, Inc., Atlanta-based contract dealers
Cleaning Management Magazine, industry statistical survey
Institute of Inspection, Cleaning and Restoration Certification (IICRC)
International Sanitary Supply Association (ISSA), cleaning rates
Peer review approval:

Michael A. Berry, Ph.D., Research Professor, University of North Carolina at Chapel Hill. Retired Deputy Director of USEPA's National Center for Environmental Assessment at Research Triangle Park, NC, where for over 20 years he was actively involved in a broad range of environmental evaluations.

Stanley Quentin Hulin, National Hard Floor Maintenance Manager, DuPont Flooring Systems.

Table of Contents

Any comprehensive maintenance and cleaning program will divide the floor space into light, medium and heavy-traffic areas and schedule the work accordingly. What this analysis envisions, however, is an entire building with light-to-medium traffic, or one with heavy traffic.

The following life-cycle cost analysis of carpet and vinyl composition tile (VCT) floor covering in school facilities is a method of depicting the true overall cost of each floor covering over a predetermined period of time.

Life-cycle cost analysis can appear quite complicated and difficult to comprehend from the standpoint of establishing the real value of a floor covering expenditure. The initial purchase cost, installation charges, maintenance requirements and associated costs, plus the costs of cleaning chemicals must be factored into the analysis to yield the true outlay of monies over the predetermined period of time.

The following analysis envisions a twenty-two (22) year time period, which is the expected usable life of VCT flooring in schools. A misguided perception of life-cycle costing is that the longer something lasts, the less the cost over time. A true life-cycle-cost analysis should include the initial purchase cost and any cost to maintain the product over the life-cycle time period in the analysis. For instance, carpet in schools has a usable life span of eleven (11) years. A 22-year life-cycle cost analysis not only includes the initial installation cost, but also an installation replacement cost after 11 years.

As stated in this study, on an annual basis, hard surface floors require two and one-half times more cleaning time than carpet. Cleaning supplies were about seven times more expensive for vinyl floors than for carpeted floors.

The attached charts compare the life-cycle costs of carpet and VCT floor coverings in school facilities over the 22-year life span of VCT. The life-cycle costs are expressed in 1999 constant dollars. Upfront purchase and installation costs for VCT are actually less than those for carpet. However, at the end of the 22-year time period, carpet expenditures prove to be more cost effective than VCT.

FLOOR COVERING MAINTENANCE PROGRAM
SCHOOL FACILITIES

Light-to-Medium Traffic Areas:

Examples: Conference rooms, teacher offices, auditoriums, limited access areas, teacher break areas, media centers, administrative office areas, classrooms used part-time.

CARPET	HARD SURFACE
Entries and Door Mats Daily	Entries and Door Mats Daily
Vacuum Daily	Dust Mop Every other day
Spot Removal 2x weekly	Spot Mopping As needed
Rinse Clean 2x annually	Wet Mop 3 times weekly
Deep Clean (HWE – 3x annual) Prior to school year (Aug) Holiday breaks (Dec, Mar)	Spray Buff (Burnish) Light traffic - monthly Med. traffic - every-other-week
	Scrub and Recoat 2 times annually
	Strip/Refinish Annually

SCHOOLS – FLOOR MAINTENANCE

School Schedule – 36 Weeks – Labor $9.76/hr. (16.3¢/minute; ref. CM survey, May 01)

Light-to-Medium Traffic – e.g., Conference rooms, teacher offices, break areas, auditoriums, limited-access areas, media centers, administrative office areas, classrooms used part-time.

CARPET	Frequency/ School Year	Minutes/ 1000 Sq. Ft.	School Year Total Minutes Per 1000 Sq. Ft.	Cost Per School Year $/Sq. Ft.
Vacuuming*	180 (daily)	12	2160	$0.3521
Spot Removal**	72 (2x wk)	12	864	$0.1408
Rinse Cleaning***	2 (May, Oct)	45	90	$0.0147
Deep Cleaning****	3 (Aug, Dec, Mar)	90	270	$0.0440
Chemical Costs				$0.0031
TOTAL			3384	$0.5547

* Anticipates thorough vacuuming 3x weekly and entry/high traffic vacuuming 2x weekly. Failure to accomplish vacuuming routinely, especially in entry areas, is a major mistake that leads to soil buildup in all areas, and ultimately in diminished flooring investment life. In other words, maintain 5% of the building area well and you can cut maintenance time in the other 95% by ⅓ to ½.

** Worst case, failure to spot clean carpet only results in unsightly appearance; not slip-fall hazards. This schedule provides 24 minutes per week per 1000 sf. Most of this probably will be done as needed for major problems, or once a week. It envisions time for light cleaning in entry areas and is almost as much time as it takes for a "rinse" cleaning.

*** Interim maintenance cleaning (hot water rinse) not only maintains aesthetics, it also extends the investment use-life, while prolonging the interval between deep cleanings.

**** Carpet is the largest horizontal surface in a building and the collection point for everything that falls out of the air. To use appearance as the criteria for cleaning intervals for any floor covering is not only foolish, but it may be downright unhealthy. Further, more frequent cleaning prolongs flooring investment life.

VCT	Frequency/ School Year	Minutes/ 1000 Sq. Ft.	School Year Total Minutes Per 1000 Sq. Ft.	Cost Per School Year $/Sq. Ft.
Dust Mopping	*180 (daily)	6	1080	$0.1760
Spot Mopping	**180 (daily)	6	1080	$0.1760
Wet Mopping	108 (3x wk)	30***	3240	$0.5281
Spray Buffing	18 (EO-Wk)	30****	540	$0.0880
Scrub/Recoat	2 (Dec, Mar) Note 1	120	240	$0.0391
Strip/Refinish	1 (Aug) Note 2	300	300	$0.0489
Chemical Cost Note 3				$0.0260
TOTAL			5726	$1.0821

* Based on 36-wk/5-day school year. Gritty soil, if not removed daily, will damage VCT finish, causing the need for increased frequency for Spray Buffing, Scrub/Recoat or Strip/Refinish. Unlike carpet, particles on hard flooring have no place to go, thus abrading the hard finish, not to mention the adverse effect on IEQ.

** Spot mopping is a band-aid on the problem, rather than a cure. It must be performed when spills occur, first to avoid slip-fall hazards, and second, before soiling can be tracked to larger areas.

*** There are 4 categories of wet mopping, depending on how aggressive the technician needs to be. This number assumes light soiling and 2000 square feet per hour (1000 in 30 minutes)

**** The speed here depends on the equipment used; e.g., a 175-rpm machine, which most in-house custodians use, produces about 1250 sf per hour, whereas a 1500-rpm burnisher produces about 3000 sf/hr. This figure assumes about 2000 sf/hr., which may be optimistic.

***** If the above schedules for dust, spot and wet mopping aren't maintained, plan to considerably increase the need for Spray Buffing, Scrub/Recoat or Strip/Refinish.

The following chart may make the CRI schedule clearer.

36-week year	Carpet Cleaning Maintenance Schedule – Light-to-moderate Traffic											
Activity ▼ Interval ►	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Vacuum	Daily (overall: Mon, Wed, Fri; traffic areas: Tue, Thu)											
Spot Clean	2 times weekly (Tues, Thu or as needed)											
Rinse cleaning (hot water rinse)					X					X		
Deep cleaning (hot water extraction)			XX					XX				XX
	VCT Cleaning Maintenance Schedule – Light-to-moderate Traffic											
Activity/Interval	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Dust mopping	Daily											
Spot mopping	Daily											
Wet mopping	3 times weekly (Mon, Wed, Fri)											
Spray buffing	2x	2x	1x	2x	2x	1x	1x		2x	2x	2x	1x
Scrub and recoat			X									X
Strip and refinish								XX				

SCHOOLS
FLOOR COVERING INSTALLATION
LIFE-CYCLE COST – 22 YEARS

Light-to-Medium Traffic

Per Square Foot

	CARPET	VCT
Materials plus Installation at year 0 (start)	$2.11	$0.89
Carpet Removal Cost after 11 years	$0.22	$0
Carpet Reinstalled (Materials plus installation) after 11 years	$2.53 (20% inflation?)	$0
Cost of Floor Covering System for 22 years	$4.86	$0.89
Cost of Cleaning and Maintenance for 22 years	$12.20	$23.81
TOTAL LIFE CYCLE COST FOR 22 YEARS	$17.06	$24.70 +31%

FLOOR COVERING MAINTENANCE PROGRAM
SCHOOL FACILITIES

Heavy-Traffic Areas:

Examples: Corridors, student break areas, classrooms, wipe-off regions, cafeterias, congested channels, principal passage routes.

CARPET	HARD SURFACE
Entries and Door Mats Daily	Entries and Door Mats Daily
Vacuum Daily	Dust Mop Daily
Spot Removal Daily	Spot Mopping Daily (& in emergencies)
Rinse Clean Oct, Mar	
Deep Clean Prior to school year (Jul) During holiday breaks (Dec, Mar)	Wet Mop 3 times weekly
	Spray Buffing (Burnishing) Every week
	Scrub and Recoat 5 times yearly
	Strip/Refinish Annually (Jul)

SCHOOLS – FLOOR MAINTENANCE
School Schedule – 36 Weeks – Labor $9.76/hr*. (16.3¢ per minute)

Heavy Traffic – Examples: Corridors, student break areas, classrooms, wipe-off regions, cafeterias, congested channels, principal passage routes.

CARPET	Frequency/ School Year	Minutes/ 1000 Sq. Ft.	School Year Total Minutes Per 1000 Sq. Ft.	Cost Per School Year $/Sq. Ft.
Vacuuming	180 (daily)	**10	1800	$0.2934
Spot Removal	180 (daily)	8	1440	$0.2347
Rinse Cleaning	2 (Oct, May)	60	120	$0.0196
Deep Cleaning***	3 (Aug, Dec, Mar)	120	360	$0.0587
Chemical Costs				$0.0040
TOTAL			3720	$0.6104

* Labor rate of $9.76 derived from Cleaning Management Magazine, May '01 industry survey.
** (Ref. notes under moderate soil schedule above) Realistically, most vacuuming will be concentrated in entry and channelized traffic flow areas. Time is largely dependent on the amount of furniture present and the width of the vacuum head.
*** Although the frequency of cleaning remains the same as for light-to-medium traffic areas, time spent cleaning is increased by 25%.

VCT	Frequency/ School Year	Minutes/ 1000 Sq. Ft.	School Year Total Minutes Per 1000 Sq. Ft.	Cost Per School Year $/Sq. Ft.
Dust Mopping	180 (daily)	8	1440	$0.2347
Spot Mopping	180 (2x wk +)*	8	1440	$0.2347
Wet Mopping	108 (3x wk)	45**	4860	$0.7922
Spray Buffing***	36 (1x wk) Note 1	48	1728	$0.2817
Scrub/Recoat	5 (Sp/Nv/Fb/Ap) Note 2	120****	600	$0.0978
Strip/Finish	1 (Jul,) Note 3	300	300	$0.0489
Chemical Costs Note 4				$0.0340
TOTAL			10,368	$1.724

* Quick response to spills on hard surfaces is essential because they don't absorb moisture like carpet. In addition to spreading the residue, there are safety (slip-fall) issues to consider.
** Although the number of wet moppings is the same as light-to-moderate traffic, time has been increased from 30 to 45 minutes. Otherwise, we just move the dirt around, which increases the need for "Scrub and Recoat" or even refinishing.
*** ***Spray buffing is not a cleaning procedure***. Absent the scrub/recoat procedure that follows, floors gradually turn brown as soil particles are fused with finish. (See Note 1 at end.

Scheduling Summary – Heavy Traffic

36-week year	Carpet Cleaning Maintenance Schedule – Heavy Traffic											
Activity ▼ Interval ►	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Vacuum	Daily											
Spot Clean	Daily											
Rinse cleaning (hot water rinse)					X					X		
Deep cleaning (hot water extraction)			XX					XX				XX
	VCT Cleaning Maintenance Schedule – Heavy Traffic											
Activity/Interval	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Dust mopping	Daily											
Spot mopping	Daily, or as spills occur											
Wet mopping	3 times weekly (Mon, Wed, Fri)											
Spray buffing	4x	3x	4x	3x	2x	1x	1x		2x	2x	2x	1x
Scrub, recoat (basically every 6 wks)		X		X					X	X	X	X
Strip and refinish							XX					

*Burnishings total 34, however, during the 36-week school year, there will be at least 2, 5-week months to make up the extra 2 for 36 total.

SCHOOLS
FLOOR COVERING INSTALLATION
LIFE-CYCLE COST – 22 YEARS
Heavy-Traffic Areas

Per Square Foot

	CARPET	VCT
Materials plus Installation at 0 year	$2.11	$0.89
Carpet Removal Cost after 11 years	$0.22*	$0
Carpet Reinstalled (Materials plus installation) after 11 years	$2.53**	$0
Cost of Floor Covering system for 22 years	$4.86	$0.89
Cost of Cleaning and Maintenance for 22 years	$13.43	$37.93
TOTAL LIFE CYCLE COST FOR 22 YEARS	$18.29	$38.82 (+53%)

*$0.22 sq. ft. is about $2.00 per sq. yd. Many contractors install commercial carpet for $0.40 per square foot or $3.60 per yard.
** 20% for inflation is figured in here. Even at 100% it wouldn't make that much difference in the conclusion drawn from this study.

Note 1 - Typically, Spray Buffing or Burnishing rates for VCT subjected to heavy traffic are:

- 175-rpm buffer - 1250 square feet per hour or 1000 sf in 48 minutes
- 1500-rpm burnisher – 3000 square feet per hour or 1000 sf in 20 minutes

Few custodial workers have high-speed burnishing equipment available, and therefore, 48 minutes is the more realistic figure to use.

Note 2 – Typically, scrub and recoat rates are:

- 500 sf/hr for light soil
- 400 sf/hr for medium soil
- 300 sf/hr for heavy soil

Further, the procedure typically involves:

1. Equipment preparation
2. Dust mopping
3. Neutral chemical application
4. Light scrubbing with an appropriate rotary unit and pad
5. 2-3 rinses to remove suspended soil and chemical
6. Application of finish
7. Optional buffing to restore gloss

To accomplish all this correctly in 30 minutes is optimistic. Chemical and equipment manufacturers often provide unrealistic time projections that simply will not hold up to scrutiny in the field. This figure, for the sake of argument, uses the highest rate of 500 sf/hr for this involved procedure (i.e., 2 hours per 1000 sf).

Note 3 - Realistic refinishing rates are on the order of 100-125 sf/hr. Even with automatic equipment, it is difficult to achieve more than 150-200 sf/hr, despite equipment manufacturers' claims to the contrary. Procedures typically involve:

1. Equipment preparation
2. Area preparation – moving furniture, file cabinets, etc. completely out of the area.
3. Dust mopping, seeping, and/or vacuuming to ensure maximum particle soil removal.
4. Aggressive chemical stripper application
5. Scrubbing with an appropriate rotary unit and pad while detailing edges and corners.
6. At least 3 rinses to remove suspended soil, dissolved finish and chemical.
7. A neutralizing rinse to allow proper bonding of new finish.
8. Application of finish; drying, application of two more coats of finish followed by drying.
9. Post project clean up.

Bottom line, it's a very involved project that requires multiple personnel and a lot of time. The figure used here, for the sake of argument, represents a very optimistic 200 sf/hr or about 5 hours for 1000 sf.

Note 4 - **Chemical costs** vary widely depending how cleaners and finishes are purchased and how carefully their use is controlled.

One company we consulted with is paying $400 for a 55-gal drum of preconditioner, the primary carpet cleaning chemical. $7.27 per gallon ÷ 128 ounces x 12 ounces per gallon = 0.68¢ x 3 gallons/1000 sf = $2.045 ÷ 1000 sf = 0.002¢ per sf. This figure does not include spotters or interim maintenance cleaners.

Light-to-moderate traffic – 0.002 x 1.5 = 0.0031

Heavy traffic – 0.002 x 2 = 0.0041

Floor finish costs $60 ÷ 5 gal = $12/gal. 1000 sf coverage x1.5 (using finish to burnish, recoat, refinish) = 1.5¢ per sf. Stripping solution is around 0.2¢ per sf. Total chemical cost is at least $0.017.

Light-to-moderate traffic – $0.017 x 1.5 = 0.026

Heavy traffic - $0.017 x 2 = 0.034

If we double both of those costs, we come up with a comparison of $0.004 (carpet) versus $0.034 (VCT), which is roughly eight times more for hard surfaces.