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Standard Guide for Selecting Economic Methods for Evaluating Investments in Buildings and Building Systems[1]

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1. Scope

1.1 This guide identifies types of building design and building system decisions that require economic analysis and recommends ASTM practices, adjuncts, and computer programs that may be used to implement the appropriate economic methods for each decision type.

2. Referenced Documents

2.1 *ASTM Standards:*

E 833 Terminology of Building Economics[2]

E 917 Practice for Measuring Life-Cycle Costs of Buildings and Building Systems[2]

E 964 Practice for Measuring Benefit-to-Cost and Savings-to-Investment Ratios for Buildings and Building Systems[2]

E 1057 Practice for Measuring Internal Rate of Return and Adjusted Internal Rate of Return for Investments in Buildings and Building Systems[2]

E 1074 Practice for Measuring Net Benefits for Investments in Buildings and Building Systems[2]

E 1121 Practice for Measuring Payback for Investments in Buildings and Building Systems[2]

2.2 *ASTM Adjuncts:*

Discount Factor Tables, Adjunct to Practice E 917[3]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology E 833.

4. Significance and Use

4.1 Standard practices for measuring the economic performance of investments in buildings and building systems have been published by ASTM. A computer program that produces economic measures consistent with these practices is available.[4] Discount factor tables have been published by ASTM to facilitate computing measures of performance for most of the practices.[3]

4.2 This guide can be used to: (*1*) identify types of building design and system decisions that require economic analysis; (*2*) match the technically appropriate economic methods with the decisions; and (*3*) locate the methods in the ASTM practices and adjuncts listed in Section 2.

4.3 More than one method can be technically appropriate for many building decisions. Therefore the choice in practice of which technically appropriate economic method to use for evaluating a particular building decision will often depend on the perspective of the user. Some examples of factors that influence the user are: (*1*) ease of applying the methods, (*2*) level of familiarity of the user with the methods, (*3*) preference of the user for different methods, and (*4*) presence of budget limitations for the projects.

4.4 This guide identifies some features and limitations of the methods that might influence users' choices under varying conditions.

5. How to Use This Guide

5.1 Table 1 indicates which standard practices (that is, economic methods) are technically appropriate for the following four types of building investment decisions: acceptance/rejection, design, size, and priority.

5.1.1 In the context of this guide, an acceptance/rejection decision pertains to the cost effectiveness of an individual building or building system. This type of decision is made independently of other project evaluations. It focuses on the merits of a single choice rather than on determining the most cost-effective design or size.

5.1.2 A design decision pertains to choices among competing designs for an individual building or building system, where only one design can be chosen.

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[2] *Annual Book of ASTM Standards,* Vol 04.11.

[3] Available from ASTM Headquarters. Order ADJE091703.

[4] BLCC5, the "NIST Building Life-Cycle Cost Program," Office of Applied Economics, Building and Fire Research Laboratory, National Institute of Standards and Technology. Available at http://www.eren.doe.gov/femp. Click on "Technical Assistance" first, then on "Life-Cycle Cost Analysis."

TABLE 1 Standard Practices For Making Building Decisions[A]

Type of Building Decision	Applicable Standards				
	LCC (E 917)	BCR (SIR) (E 964)	IRR (E 1057)	NB (E 1074)	PB (E 1121)
Acceptance or rejection	B	B	B	B	C
Design	B	D	D	B	E
Size	B	D	D	B	E
Priority or ranking	E	B	B	E	E

[A] All of the practices require discounting operations, but only Practice E 917 explains discounting in detail. All of the methods can be applied using techniques for treating uncertainty and risk. Practice E 917 discusses briefly some of these techniques. The other practices do not discuss them.
[B] Technically appropriate standard practice when total discounted benefits (savings) and costs are considered.
[C] Note limitations in Table 3.
[D] Technically appropriate standard practice when incremental discounted benefits (savings) and costs are considered.
[E] Not recommended.

5.1.3 A sizing decision pertains to choices among competing sizes or investment levels for an individual building or building system, where only one size or level can be chosen.

5.1.4 A ranking decision entails choosing one or more projects from a group of cost-effective projects when the available budget is not sufficient to fund them all.

5.1.5 Examine Table 1 to find which methods should be considered for a given decision. The ASTM designations are given in parentheses under the method names.

5.2 If there is any doubt as to which type of building decision shown in Table 1 best applies, consult the examples in Table 2. Table 2 lists examples for each of the four types of decisions shown in Table 1. Find in Table 2 a building decision similar to the one being analyzed, and select the corresponding decision type from Table 1. Section 6 contains illustrative cases of this process.

5.3 Once the type of decision has been identified and Table 1 has been consulted for the technically appropriate method, there will be several methods from which to choose. Note that while all of the methods that are marked as appropriate for a given decision will generally give answers that support the same decision (with the exception of payback), there are likely to be special considerations that make one or more methods preferred over the others. Examine the special considerations listed in Table 3 before making a final choice of methods.

5.4 Examine the practice(s) that corresponds to the chosen method(s). In the selected practice(s), read the sections on significance and use, applications, and limitations. If the practice(s) still seems appropriate, follow its procedures. If not, repeat the process using Tables 1 through 3 until an acceptable practice has been found or it has been determined that none of the practices is suitable for the decision at hand.

5.5 For assistance in calculating the measure(s) of economic performance provided by the selected method(s), use the adjunct and BLCC5[4]. The adjunct on Discount Factor Tables supports manual calculations for all of the methods. The Building Life-Cycle Cost Computer Program (BLCC5) supports computer calculations for all the methods except net benefits where revenues are involved, and payback.

6. Illustrative Cases

6.1 Section 6 illustrates how to use this guide to choose the appropriate practice for each of the four types of building investment decisions listed in Table 2.

6.2 *Acceptance or Rejection Decisions*:

6.2.1 If it is known (by recognition of the type of decision or by having examined examples in Table 2) that the building decision to be made is one of accepting or rejecting an individual project, then a choice must be made from the five practices listed in Table 1. To illustrate how such a choice might be made, an accept/reject building decision is evaluated in terms of the special considerations in Table 3.

6.2.2 An example of an accept/reject building decision is whether to install a programmable time clock to control heating, ventilating, and air conditioning (HVAC) equipment in a commercial building. The time clock would reduce electricity consumption by turning on only that part of the HVAC equipment that is needed during hours when the building is not occupied. Each of the five practices indicated in Table 1 for this

TABLE 2 Examples of Building Investment Decisions

Type of Building Decision	Examples
Acceptance or rejection	A.1 Is a water heater insulation kit cost effective?
	A.2 Are fire sprinklers cost effective?
	A.3 Is a given control system cost effective for managing HVAC equipment?
	A.4 Is a solar hot water system cost effective?
Design	D.1 Is single, double, or triple glazing most cost effective?
	D.2 What heating system is most cost effective?
	D.3 Which orientation of a building is most cost effective?
	D.4 Which code-approved plumbing system is most cost effective?
	D.5 Which wall type (for example, masonry, wood frame, curtain wall) is most cost effective?
	D.6 What floor finish (for example, carpeting, tile, wood) is most cost effective?
	D.7 What kind of insulation (for example, cellulose, fiberglass, rigid foam) is most cost effective?
	D.8 Is an item with low first costs more cost effective than a more durable substitute with higher first costs?
Size	S.1 What is the economically efficient level (*R*value) of insulation in the walls and above the ceiling of a house?
	S.2 How many square feet of collector area should be installed in a solar energy system?
	S.3 What heat pump efficiency (for example, HSPF 1.75, 2.0, 2.25) is most cost effective?
	S.4 What furnace efficiency (for example, AFUE 60 %, 75 %, 90 %) is most cost effective?
	S.5 What air conditioner efficiency (for example, SEER 7.0, 9.0, 11.0) is most cost effective?
Priority or ranking	P.1 What combination of investments in a given building (for example, new water heater, new floor tile, and new lighting system) is economically preferred when each is justifiable on economic grounds, but insufficient funds are available to pay for all of them?