

- Site improvements (grading, roads, fencing, buildings)
- Installation labor and management
- Financing cost during construction
- Shipping
- Taxes
- Licenses, permits.

For large systems whose installation may extend over months or years, a schedule of installation and expenditures will also be needed to properly compute economic measures as defined previously.

*Steps 10, 11, 12, 13, 14, 4: system cost (manufacturing-cost modeling).* Figure 21.2 shows two paths to determine the system cost. The path utilizing commercial technology has been addressed in the figure. When a PV cell/module technology that is not commercially available is to be considered, predictions of the cell and/or module cost are required. One approach to predicting the cell/module costs is shown in Figure 21.2 (Step 12) as a cell/module-manufacturing cost model. Such a model was developed at the Research Triangle Institute under the sponsorship of the Electric Power Research Institute (EPRI), and was used over a period of years in studies of the cell and module costs [3]. This modeling approach, which eventually came to be called Strategic Analysis of Manufacturing Product and Price (STAMPP), is briefly described here to illustrate how cell/module costs can be predicted.

The objective of STAMPP is to model the operations of a cell- or module-manufacturing firm in such a way that the annual required revenue of the firm is calculated for a specified annual production volume. The required revenue divided by the production volume gives a required unit price for the cell or module. The term *required price* is used because all direct and indirect costs and after-tax profit are included in the revenue. The required price is thus the minimum price for which the product could be sold while returning the specified margin of profit. However, the market would always determine the actual selling price. A further objective of the model is to facilitate the parametric analysis of a wide range of cost factors so that the cost drivers can be identified and their effect on the required price of a cell or module design can be explored for a specified manufacturing process.

The firm is described in the model by a fixed organization whose top management levels are filled by a fixed number of people. The lower levels of the organization, including supervisors, production, and support staff are filled by a number of employees, which is scaled to the manufacturing requirements. Hours of operation, meteorological data for heating/cooling loads, and other firm-level financial and operating data are included among the input.

The physical operations of manufacturing are modeled in STAMPP using the concept of a “workstation”. A workstation is defined as a collection of one or more identical machines, each performing the same operations in parallel. The user specifies the direction of workflow among the workstations.

The user defines the operations performed at a workstation on a per-machine basis. The model calculates the number of machines for each workstation based on a specified