2.3.6. Technical specifications

Work Breakdown Structure (WBS)

Three methods for project breakdown are used for construction project management:

- The functional breakdown structure (FBS) is suitable for identifying project functional components.

- The work breakdown structure (WBS) is a method for dividing the project into small work packages, tasks or activities.

- The product breakdown structure (PBS) is used for breaking down the construction facility (i.e. the construction product) into its constituent parts.

The FBS is often used by clients in their project requirement specifications. For instance, a client may wish his or her building to have one conference room two offices and a sanitary installation on the ground level. Accordingly, designers are expected to develop their projects to cope with client requirements in the same format. Actually, the FBS is a convenient method in the early stages of project design, because it facilitates communication between the client and the design team. For very large projects, clients may wish to get a broader view of their project by adopting a breakdown structure at the facility level. This type of structure is sometimes called the facility breakdown structure.

The WBS is one of the most important tools for project planning. The WBS provides a complete list of project activities defines responsibility of project team members and enables a classification system for project work packages according to client needs. The WBS for a typical construction project evolves from an initial task which is successively subdivided into smaller work blocks until the lowest level to be reported or controlled is reached. This treelike structure breaks down the project work effort into manageable and independent work packages. The lowest level corresponds to the smallest project work packages and the shortest completion time periods to manage. The classification format of work packages may include fields for responsibility, cost centre, activity numbering and so on. Figure 2.4 below depicts a typical WBS for a construction project.

The WBS approach is convenient for activity definition because it is process-oriented. Activity definition is the starting step for project planning, which may have several dimensions such as, budget, time, cost, quality and so on. However, construction cost planning tends to be product oriented in Europe because of the contracting systems used for

most construction projects. This may be inconvenient for control purposes because monitoring in the project life- cycle is based on processes rather than on products.

While the WBS is process-oriented, the PBS is product-oriented and structures most construction cost planning and management systems. Bills of quantities (BOQ), which are widely used in European construction, are typically generated under a PBS approach. However, they have been criticised for their lack of relationship to the construction process on site. This is specially felt in building projects, for which a bill item may relate to works to be carried out in different locations and time instances. For other types of projects, for example road projects, bill items tend to be more similar to construction activities, therefore making BOQ much more process oriented. Another criticism of BOQ is that although they are relatively easy to work out from the complete design, they are much more difficult to establish in earlier stages of project development. Therefore, other PBS instead of BOQ may be used at those stages.

Using a PBS for cost management purposes has several advantages:

- It allows for unit rate estimating which is a rational approach to cost estimating;

- It enables benchmarking of cost estimates against industry-level data sets such as the indices produced by the Portuguese Laboratório Nacional de Engenharia Civil (National Laboratory of Civil Engineering - LNEC) or by similar institutions of other countries;

- It creates a budget baseline for contracting and against which cost control may be easily performed during project execution.

The PBS is also adequate prior to the complete design being available. In earlier stages of project development, costs per unit may be benchmarked against pre-established rates. Frequently, target rates are established within which the project budget may stay. At the initial stages of the project, unit rates may be used, for example, cost per bed for a hospital or a hotel, cost per seat for a cinema, cost per pupil for an educational building. As the project evolves, other unit rate approaches may be adopted, such as cost per square of gross area in a building, cost per kilometre in a road and so on. As more design data becomes available, cost information may be broken down into an elemental cost plan. Finally, the lowest level of detail of the PBS is provided by the bill of quantities.

From the above discussion, it may be concluded that three distinct breakdown structures may possibly co-exist in construction project management. This may be a problem for control

purposes because cost, planning and other management functions are thus supported by distinct data structures. Actually, lack of functional dependency is often found in management data in construction projects leading to monitoring and control problems in the construction industry. The solution for this implies management data to be sufficiently detailed, therefore enabling distinct data structures to be built. An elementary data entity common to several data structures (e.g. construction task) may thus re-establish functional dependency (e.g. between planning activities and items of the bill of quantities).

Irrespective of the project breakdown structure adopted, defined work packages will be tied to attendant schedules and budgets for work performers involved in the project. Thus, it is desirable for the lowest work packages to correspond to small work portions and short time periods. It is often helpful to indicate who the task leader is and to adopt a sound coding system enabling easy matching between project activities and items of the bill of quantities.