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TECHNICAL SPECIFICATIONS FOR CONSTRUCTION PROCESSES WITH BIM

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Within the construction process, we find a great deal of information that interests contractors, owners, designers, project managers and all people generally involved. The aim of this research was to organize all the information related to materials, products and parts, workers, equipment. This dossier (paper, study) is structured into five parts as follows: List of resources needed for the works; Resources analysis; Definition of the acceptance conditions for every working action related to the tasks and every production phase (initial, follow-up, final controls); Waste and emissions management; H&S aspects. Our model entails the identification of working actions in the following four processing stages: transport from storage (area) to processing area, preparation of materials needed for works, materials transportation to the installation area, implementation. The research was complemented by checks and tests performed on some companies involved in the project. Then all this information was entered in the BIM object. The aim was to manage operational information with the aid of BIM model. The sheet is configured as a valid support for an exhaustive analysis of the whole work process, both from a constructive, technologies, construction techniques and economic point of view, intended as a support to an early estimate and to a later accounting.

Keywords: Management, Building information modeling, Operational plans.

1 INTRODUCTION

The orderly management of operational information in the building process is essential to ensure continuity between the design (phase) and the execution phase. This research originates from a previous job (Di Giuda *et al*.2014) and aims to create the operational information system required for the proper installation of components, products and materials, creating a database connected to BIM objects. To this end a series of tabs, tab processing, a data pipeline, the labor card, the card means (for safety) were drawn up. The aim of this research is to provide BIM objects with all data related to the execution phase and the construction site management.

Usually, buildings are divided into parts by WBS. Each part has its requirements and characteristics described in characteristics, performance, sustainability information, business information and other informations concerning their definition. The research stems from the need to organize also operating information by describing in a precise and timely manner the execution of the work provided and collecting a variety of information from the analysis of the construction planning requirements.

It is obvious that the reasons that led to the drafting of this sheet, are the same as the Operational Planning basis: to develop "the indications and guidelines [...] necessary for

the proper performance of the construction phase, consistently with the spatial-functional design and technology" [UNI 10756:1998].

Since the operating procedures may vary from time to time, not only in terms of the item to be realized, but also of the context in which you operate and the available resources (Zignoli, 1956), this sheets to be considered as a kind of synthesis and a *trait d'union* element concerning all the other project-related information.

2 INFORMATION

Data related to building process were organized in different sections including all information required by the general contractor or building companies to implement the process. The goal is the development of an information system that is currently managed in no-systematic way. This information has been divided into six chapters:

(1) Analysis of resources needed for processing

(2) Resources accounting

(3) Operational constraints

(4) Operating modes and in-execution controls

(5) Waste and emissions management

(6) Health and safety management and risk analysis

Since the similarity between our research aims and the Operational Planning's, is obvious, the accordance within the contents of the "Process Dossier" and the Operational Plans is unavoidable: contractual conditions and priorities, products, tools, means of work and the operations team necessary for the execution, the procedure for the production, timing and expected costs.

Particular attention was paid to all those aspects that affect the operating modes selection: the available resources and the context in which you operate (Angelici *et al.*, 1999).

To determine how to implement a certain work item, in fact, you cannot merely choose the products that it will be consist of, but you need also to consider the type of machinery and preparations you are going to adopt, which of them are/is already present in the yard and where the processing will be carried out (Di Giuda *et al.*, 2011).

2.1 Management of Resources

The company must first identify what resources are needed to carry out the work: as a result, all the construction products are to be listed alongside with their package details report, and the means it intends to use. All this information is implemented with parameters entered into BIM object as it is shown in Figure 1.

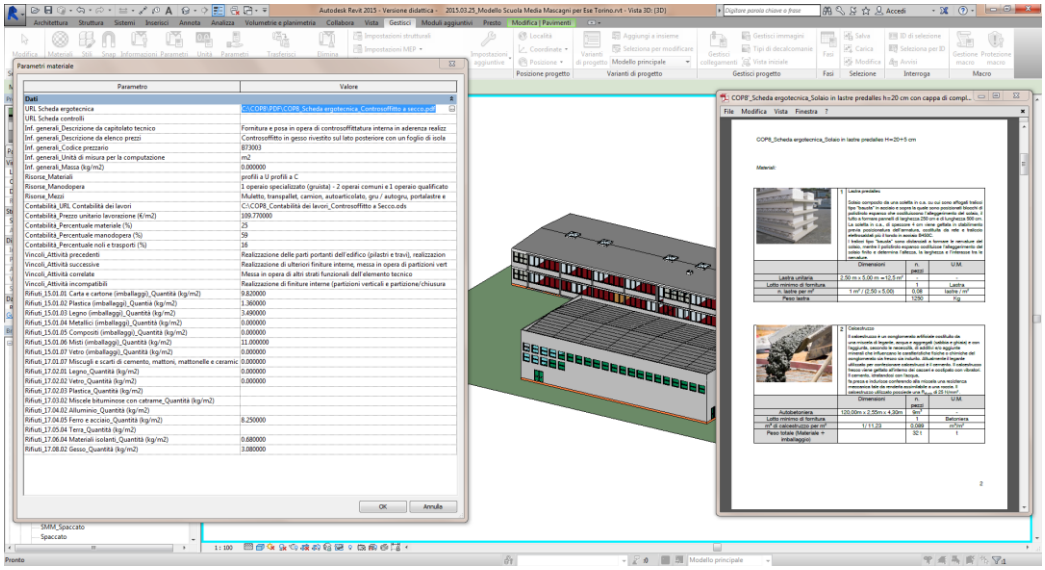

Figure 1. Operational information linked to BIM object.

2.2 Evaluation

At this point, a switch is made to an economic assessment of the resources, i.e. the section that has aroused most interest in the companies the authors dialogued with during the sheet processing.

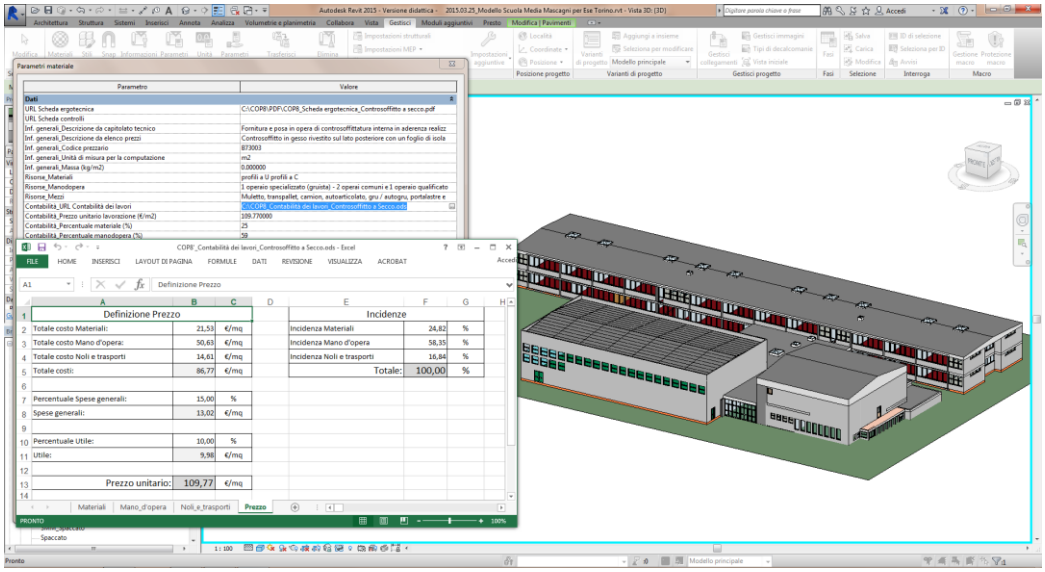

Figure 2. Economic data: material costs, machinery costs and workforce costs.

This section is designed to report the cost of the item in the project work to be carried out, which is essential for subsequent accounting, and all construction products, machinery and equipment, human resources and preparations that constitute an expense for the firm, with the respective amounts and costs.

Especially, you are supposed to enter, for all construction products selected, the unit quantity, taken from the Technical data sheet of product, the total amount, adjusted by a correction coefficient, and the cost per unit, according to the price lists of the individual enterprise, thus obtaining the materials' total cost. The same holds for the workforce, after having identified the operating team members and considering the hours of work needed to obtain the items under work.

In the machinery and equipment computation, you only need to consider those items characterized by high rental costs, while excluding those with a minimal impact on the total company's expenses. Also in this case, the total costs of machinery and equipment as well as those related to the preparations are obtained.

2.3 Construction Sequences and Controls

In this section contractors and subcontractors have to report all the operational constraints related to any specific work: previous activities, related activities and subsequent activities, that conflict with warnings and Conditions. This information, in fact, is essential to define the spatial and temporal organization of works, the operations to be carried out before the beginning of the activity and the contractual obligations the executor needs to comply with.

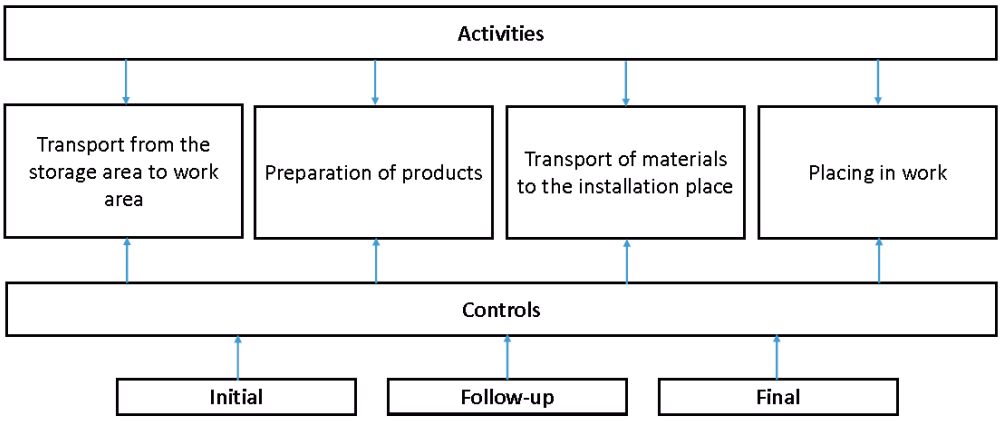

Figure 3. Scheme of sequences of construction and controls.

At this point, processing can be defined and analyzed. In order to conduct a detailed and thorough study, it is necessary to identify the constructive actions the processing is articulated in, by dividing them into four phases:

- Transport from the storage area to work area
- Preparation of products
- Transport of materials to the installation place

- Placing in work

The choice of these four stages was dictated by the desire to analyze all and only the processing stages in which only the members of the operating team are involved and that are designed to achieve the specific item realization. For this reason, we have deliberately neglected the on-yard materials supply phase.

Operational sheets are linked to all BIM objects in order to provide all working process with all the information needed to complete the works.

2.4 Environmental Management

This section was created with the purpose to lead companies to make environmental evaluations and therefore to assess their own processes impact in terms of waste production and emissions. If you consider the yard, in fact, you can easily imagine the extent of these problems and the actual need to manage them adequately.

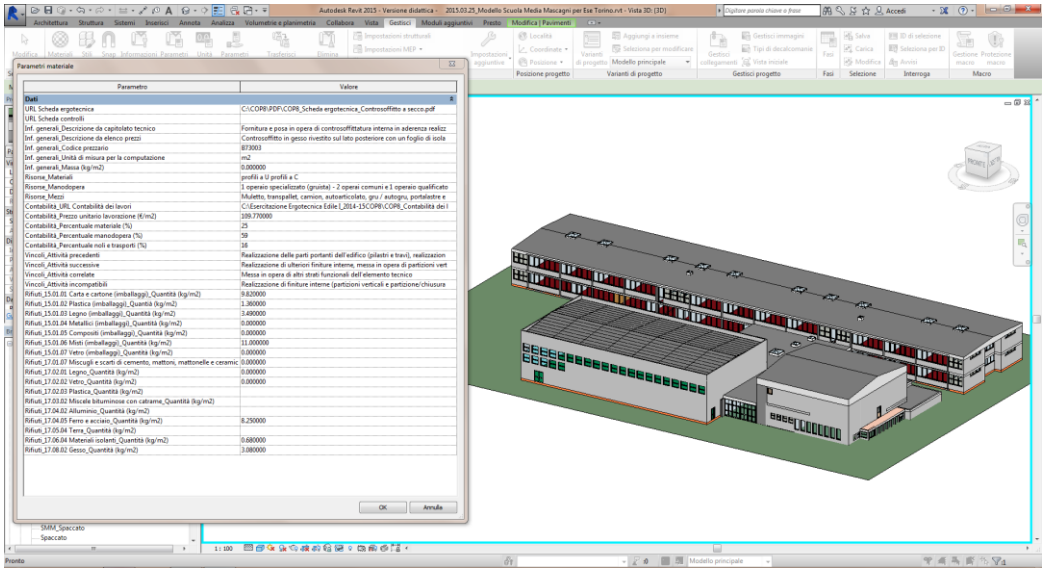

Figure 4. Environment information about waste management and emissions.

As to waste management, we have provided a table in which to evaluate the amount of waste the employed products generate, with the aid of some coefficients. In addition, you can calculate the percentage you may want to allocate to the reuse on building site, on yard reuse with treatment, reuse in a different yard, recycling and disposal.

Conversely, as regards the emissions management, it is necessary to indicate which machinery emits CO2, how long it is used for the processing concerned, the respective unitary emissions and the consequent total emission due to the single piece of equipment suitable for the specific processing.

Waste-related information, with CER code, is associated with every BIM object, on order to evaluate, during the design phase, quantities, typologies, and waste disposal procedures.

3 CONCLUSIONS

The result of this research was the definition of a work-sheet that takes into account all the information pertaining to the yard activities. The information was subsequently included as parameters in the BIM objects and materials that make up each state of the project technological system. Then the corresponding parameters to be associated with BIM objects, that bring with them all the information performance as well as technical and economic considerations necessary for the management of its execution in the yard, were defined.

Thus it is possible to manage more information and, through the extraction of schedules, immediately assess the amount of resources required, the possible means in the yard, the workforce qualifications and costs. It is also easily calculable management, installation mode, control and machining acceptance.

Such an in-depth analysis is useful to ensure ultimate item high quality and greater safety for workers as well as to facilitate information dissemination among all the operators concerned.

The internal structure of the sheet was validated for several processes, which differ deeply from each other. In doing so, we found out that it is a very useful and effective tool to investigate any type of yard activity.

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