Application of General Purpose Project Planning & Programming Software for Production Planning & Control in Plants which Produce Prefabricated Building Components

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ABSTRACT

The "open systems" in building prefabrication may be qualified more flexible to some extent compared to the closed ones and may use the tools and approaches used in industrial production areas for the estimation of demand and production. As for the closed systems in particular, it is not possible for these systems to apply this kind of an approach. Their production must be based on absolutely assured demands and projects. Because of this, they need detailed projects and assembly schedules for production. As a result of this, their production modes can be qualified "custom-made" type and production planning functions must provide the demand values from the assembly schedules of contracted projects. The problem can be solved by integrating the work schedules of the sites that are served by factory. Integration of data on a computerized system will be preferable and it is possible to realize the model in two alternative ways. The first is developing a new conceptual model and convert it into a software and the second is developing an approach for customizing general purpose project planning and programming software for using them in production planning. The second solution is studied in the paper following this. The aims of this study are analyzing outstanding general purpose project planning & programming software from the point of view of requirements of production planning function and their customizability; comparing the requirements of the model designed for production planning and capabilities of general purpose planning software and developing the conceptual and practical dimensions and basic principals of the model for using the general purpose planning and programming software for production planning.

1 COMPUTER-AIDED PRODUCTION PLANNING IN PREFABRICATION

1.1 **Determination of Problem and Its Background**

When the traditional technologies become insufficient in building production new technologies arise for solving the problem of producing large scale projects within lesser time and cost. These efforts reached to a final point via prefabrication. The basic requirements for industrial production like division of work, standardization, repetition, specialization, mechanization etc. are not enough for qualifying the production as an industrial production unless providing a production for stock.
Although, the final purpose of prefabrication is defined as reaching to an industrial production, if the continuity and stability of demand and the standardization of open

systems in prefabricated components can not be obtained it is not possible to reach this target.

In the countries where these basic characteristics of demand do not exist an industrial production and a production planning approach suitable for industrial production can not be applied. The factory can not accept to keep the components that are not definitely known when will be ordered because this is not going to be the right way for utilizing its limited resources. At present, though the production of some prefabricated elements like pavement border, lighting elements etc. is possible for stock, custom-made approach is inevitable in production of building components .

Due to this, the factories that are going to produce these components must know the definite amount of demand and its value in time. The only data for the factories to realize these, are the assembly schedules in sites and for this purpose the work schedules of the sites that are going to be responded by the same factory must be integrated. The conceptual and practical models developed by the author (Kanoglu, 1991) for solving this problem take place within the content of the other paper prior to this one in these proceeding.

There are two alternative ways of integration of the work schedules of sites and determining the types and amounts of building components for production planning in a computerized system. Firs one is to develop a new software and secondly using one of the existing software produced for production planning. The firs approach and the model developed for showing the principals of this kind of a solution is stated above.

Although developing a new software can be seen preferable in some cases, this approach brings some difficulties with it. Software development is an expensive solution in general and it is necessary to update the product according to new requirements. Apart, the bugs determined in usage stage must be found and corrected. Due to these reasons the continuity of the unit developed the software is inevitable. This function is undertaken by an interior department of company in some cases that software companies can not provide this continuity.

As for the special purpose software for production planning, these products are mostly expensive, specialized for certain types of production areas and can not be customized for desired production areas.

The basic functions and the modules corresponding these functions that must be provided by the model designed for solving the problem are basically in database form. Only the module required for preparing work schedules of sites is a general purpose project planning and programming module. For both database and planning functions there are numerous and perfect software. The only problem is how to integrate these products.

The problem can be solved by customizing these customizable general purpose database and planning software and integrating them according to the principals of the conceptual model that will be developed. When these software in both categories are analyzed it can be seen that some of them are more suitable for this purpose than the others.

In this paper, it is not aimed how to integrate the database and planning software, but the principals of using general purpose planning and programming software for

production planning function in a factory that produce prefabricated building component is studied in conceptual and practical dimensions.

1.2 **The Aim of Study**

The aims of this study are explained below:

- Analyzing outstanding general purpose project planning & programming software from the point of view of requirements of production planning function and their customizability.
- Comparing the requirements of the model designed for production planning and capabilities of general purpose planning software.
- Developing the conceptual and practical dimensions and basic principals of the model for using the general purpose planning and programming software for production planning.

2 BASIC MODULES OF THE SOFTWARE TO BE USED FOR PRODUCTION PLANNING

The functions that must be fulfilled by computerized system are expressed as follows:

- Determining the assembly schedules
- Determining the delivery schedules
- Monitoring factory and site productions
- Updating and revising programs
- Integrating (merging) the projects and preparation of reports

Related to these functions, the components of the system, which will overtake these functions are designed as follows:

- Building/Plan Types Definition Subsystem
- Prefabricated Building Components Definition Subsystem
- Inventory Control Subsystem
- Factory Mould Types Definition Subsystem
- Project Planning/Programming (scheduling) Subsystem
- Projects & Data Integration/Evaluation Subsystem

3 THE CAPABILITIES & STRUCTURE OF GENERAL PURPOSE PROJECT PLANNING & PROGRAMMING (GPPP&P) SOFTWARE

3.1 **Analysis of (GPPP&P) Software**

General purpose project planning & programming software packages are categorized in different ways. One of these categorizations defines four levels; very high-end, high-end, mid-end and low-end packages (Westney 1993). Due to these levels the prices, capabilities and capacities vary from each other. Low-end software are relatively have lesser price, detailed capabilities but can not be used for large scale projects. They have limitations for the number of resources and the number of

assigned resources to an activity, the number of relationships among activities and the number of calendars etc. and there is not network versions of them. Mid-end and high-end category software have additional features and do not have these constraints but they are more expensive as well. A detailed analysis structure for these software was developed by Kanoglu (Berköz et al. 1994) and DOS versions of six software was analyzed as well. Then Windows versions of three of them was analyzed in another study (Kanoglu 1996).

The packages can be analyzed from the point of view of general system approach under three main headings; input, process, output.

Input (Data): The data and which is required by planning software for fulfilling the planning function, possibilities and constraints of data input in these software can be analyzed under this heading.

The planning software on market provides various user friendly tools when inputting the data. These facilities can be stated on activity and project levels. Especially for the projects that consist of repetitive units copying and duplicating the data defined for one unit is an advantage. After duplication these units are linked to a master project as sub projects or merged in one project. Apart this, it is possible to transfer the data defined before as work patterns, project calendars, individual resource calendars, resource pools, activities and all data related to activities to new projects. Apart transferring data within the software, it is possible export or import data from out of the software. In other words, data can be obtained from or provided to database or spreadsheet software. Some packages support this transmission dynamically via Dynamic Data Exchange/Link (DDE/L) feature. The data can be defined in various ways like table, form, WBS chart, activity tree, network diagram or bar chart formats.

Process (Learning/Operations/Usage): Learning and usage of these software can be analyzed under this heading. The vendors of software provide tutorials, manuals, periodical courses, on-line problem solving hot-lines in addition to packages. Apart, some features like the simplicity of the architecture and menu structure of software may get easier learning the product. Some packages give the possibility to toggle between beginners and expert mode menu structures.

Some utility functions (data transferring, backing up files, merging files etc.,) provided by software makes some utility software unnecessary. In defining the activities and their relationships with others it is possible to use one or more of three layouts or presentation technics. These technics are bar chart, arrow diagram and precedence diagram. The software differ from each other due to these layout capabilities too. In addition to these features, standard and user defined code structures, filter grouping, ordering capabilities, error handling and help facilities are advantages of some packages.

GPPP&P software differs from each other in relationships with hardware system. Low-end, mid-end and high-end category software need different size of memory and fixed disk capacity. These products need a high performance processing unit not under 80386 category and preferably 80486 or pentium for IBM compatible systems.

The software having graphic interface support VGA and SVGA electronic video cards while others support EGA and CGA resolution.

One of the basic points in relationship between software and hardware is that if the software is multi-user or not. Some companies produce the network and PC versions of software and some of them develop only PC version.
Output (Reports): The types of reports, contents of reports and formats of reports can be analyzed under this heading. These software can send the reports they produce to some or all of the output devices like printer, plotter, monitor etc., Except these ones, it may be possible to send these reports in some formats that can be read by word-processing, spreadsheet or database software.
As for the types of reports, these software basically can produce tabular activity schedule reports, bar chart reports, network or pert chart reports, resource usage reports, cost reports. The software provide user defined report contents in addition to standard report contents. Customization of layouts and report contents are important features of these packages. The user may use user-defined activity, resource or cost account code structures in addition to WBS, RBS, OBS coding structures provided by software for organizing (grouping, filtering, ordering) the content of reports. The outlining feature makes it possible to define activities in a hierarchical structure and reporting in different details by collapse/expand or summarize/roll-up functions. Ýt is not possible to find all these features in all packages and sometimes it is possible to see some misinformation in documents (Levine 1993).

3.2 **The Basic Features of GPPP&P Software that is Convenient for The Model**

The features and capabilities of general purpose project planning & programming software are ordered above by integrating all the features supported by the software packages analyzed in this study. As different software in different categories have different features they do not contain all of these capabilities. The general purpose planning & programming software that is one of the main components of the conceptual model described in Heading 4 must support some of the features stated above absolutely for corresponding the expectations of the model and the process defined within the content of model. The features of the software are stated below:

a. Multi-project planning feature
b. Linking feature of the resource pool of master project to the sub projects
c. Transferring feature of the resource pool of master project to the sub projects resource pools
d. User defined activity codes structure creating feature
e. A strong filtering, grouping and ordering feature
f. A flexible resource coding, resource grouping or wild card operation feature
g. Unlimited number of resource definition feature
h. A flexible cost account code structure creating feature
i. A strong export/import feature with database software
j. Duplication and copy/paste feature
k. Flexible report preparation feature
l. Mailing feature

Though most of the low-end, mid-end and high-end category package have these features, some of them do not contain all the capabilities mentioned above. In order to customize these general purpose planning software for production planning the basic point is to consider the prefabricated components for example as materials and to define them as resources as it was stated before. Due to this approach, all reporting capabilities of these software can be utilized by means of the building/plan type codes assigned to assembly activities and resource codes corresponding to the components. Due to this, these software must support flexible and strong activity, resource and cost account codes and user defined structures for these codes. Some of the low-end category software does not support data export/import features to and from database software for designing a complicated and integrated model.

4 THE METHOD SUGGESTED FOR PRODUCTION PLANNING IN PREFABRICATION BY USING (GPPP&P) SOFTWARE

The steps of customizing the general purpose project planning & programming software for production planning purpose are described below. Thus, these software can be converted to special purpose packages.

Step 1. *Preparation of Work Schedules of Sites Using GPPP&P Software (Creating Activity Data-base):* The sites can make up their work schedules by using a compatible software to the factory's package. This schedule contains all the activities comprising the project. It is an advantage that these software can export/import data to each other in both first planning and updating stages. There are some packages that the producer companies released a high-end and low-end category product by customizing their contents and capabilities.

Step 2. *Description of Assembly Activities Within These Schedules:* As all activities within the content of projects, the assembly activities must also be defined and their duration and relationships with other activities must be described.

Step 3. *Description of The Master Project that is going to be linked by the projects as Sub projects:* The Master Project that integrates all the work schedules of linked sites sub projects is described.

Step 4. *Description of All Prefabricated Components as Resources in Resource Pool of The Master Project (Creating Resource Data-base):* The factory wants to know the required amount of every component in time dimension for production planning. Due to this, prefabricated components must be considered as "resources" and defined in resource pool of The Master Project.

Step 5. *Description of Usage of The Master Projects Resource Pool by Sub projects or Transfer The Resource Pool to Sub projects:* The sites have to assign the prefabricated components to assembly activities as resources so that the factory produces the reports showing the required amounts of the components in time. Because of this situation there are two ways; in some software packages the user can define a link among the master project and the sub projects. In the other way, the user transfers the resource pool from the master project to the

sub projects and every sub project uses its own pool. Thus, there will be no need for comprising the resource data-base for every sub project.

Step 6. *Coding All Components in Detail of Secondary Level Characteristics (Alternative Way of Creating Resource Data-base):* Some software package does not have strong and flexible enough capabilities for resource coding and definition. If the capabilities of these packages more flexible in defining cost account codes, the code structure can be defined by user and some reports showing the amounts of the components defined in primary characteristics detail by grouping them in secondary characteristics level.

Step 7. *Creating The Code Area in User Defined Activity Codes Pool That Will Be Used for Filtering Assembly Activities:* The assembly activities must be assigned a code that is going to be used for sorting them from the other activities. These codes assigned to every assembly activity shows that the activity is an assembly activity and the type of building which have different type and amounts of components from the others.

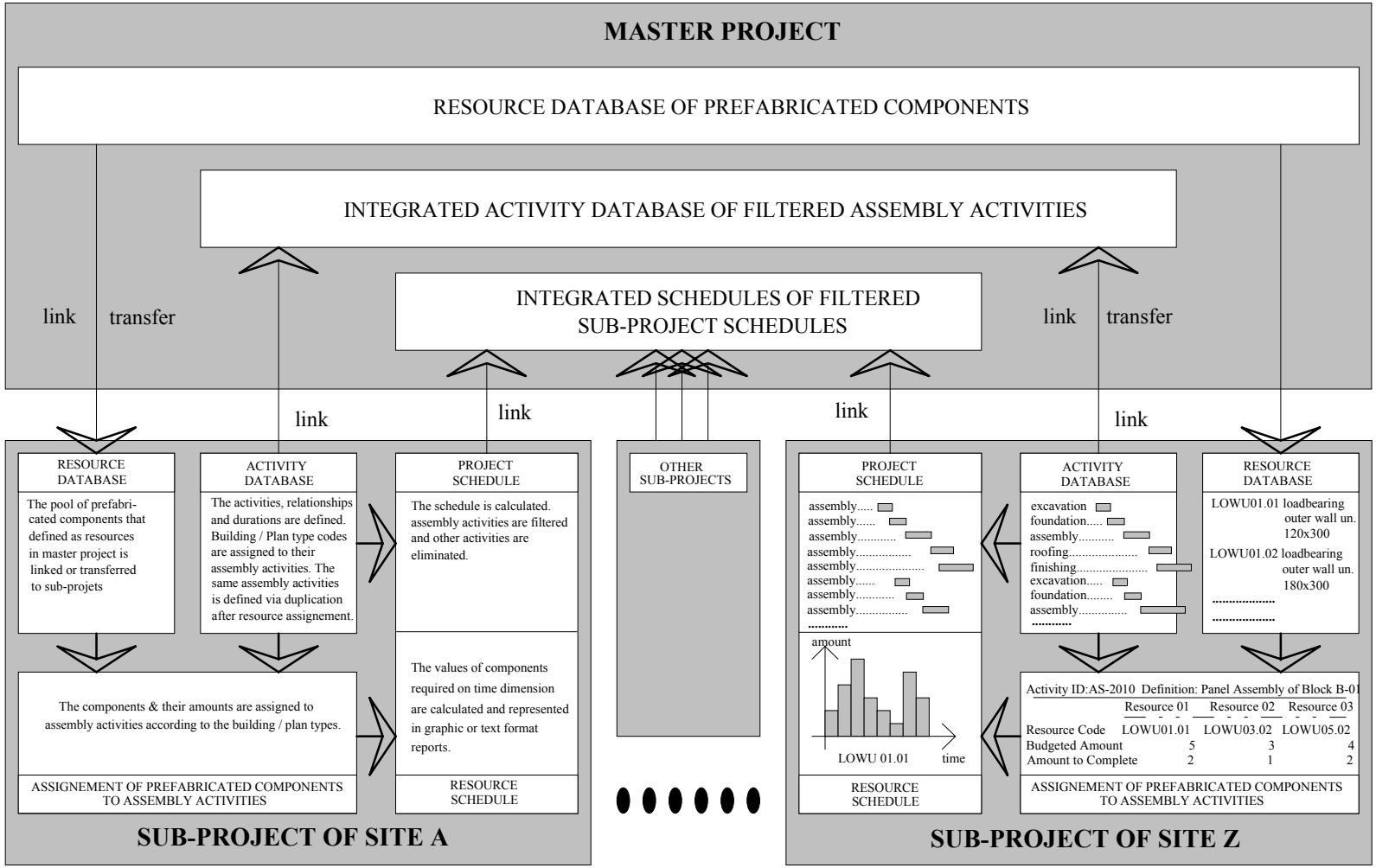
Step 8. *Assigning The Building Type Codes to Assembly Activities:* After the code area being created by user the sites must assign the building type codes to assembly activities in their work schedules.

Step 9. *Calculation of The Schedules of Sites:* After defining all data and assigning codes, calculation of schedules and resource leveling are fulfilled.

Step 10. *Describing All Projects as Sub projects of The Master Project:* The Work schedules of current sites and new sites joining to the customers of the factory are defined as sub projects of the master project and linked to it.

Step 11. *Production of The Reports of Components Requirements:* In coding prefabricated components there are two basic points for production planning function. The code firstly must show the type and dimensions of the component. These characteristics are named as primary characteristics for assigning the components to moulds. Due to these requirements, the coding structure contains firstly four alphanumeric characters that shows the type of component and two numeric characters following the former corresponding the description of different dimensions of same type of components. The same components in type and dimensions are different from each since they have different window or door spaces, different installations and different surface textures etc. For this reason, two digits numeric characters complete the coding structure in order to define this differentiation (see the other paper of the author prior to this one). The factory must consider the mould capacity, types and dimensions of molds, the required amounts of components in time, how to assign the components to moulds etc. in production planning. Due to this, sometimes the reports integrating the amount of requirements of components in primary characteristics level (in size of components) may be demanded. But sometimes, for organizing the site based delivery reports the organization of reports in secondary characteristics detail is required.

Figure 1: **The Conceptual Structure of The Model**



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