Application of PSL to construction process information specification and exchange

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Appendix A:

Appendix A:

Glossary for AutoCAD, CCS, and Microsoft project software applications terms:

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### Table A.1: Glossary for AutoCAD Design Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object-</td>
<td>Elements of AutoCAD application. A line, view, layers, and combination of those such as door, window are examples of AutoCAD objects.</td>
</tr>
<tr>
<td>Property</td>
<td>An attribute of AutoCAD objects. Colour, Layer, dimension and any attribute attached to objects are properties of AutoCAD objects.</td>
</tr>
<tr>
<td>Object Browser</td>
<td>An object browser displays the available classes (objects), properties, and methods in a dialog box of the applications. It can be used to find and use objects that are created, as well as objects from other applications.</td>
</tr>
<tr>
<td>block</td>
<td>A block is a collection of objects that can be associated together to form a single object, or block definition. A block can be exploded into its component objects, for detailed data.</td>
</tr>
<tr>
<td>Block Object</td>
<td>A block definition containing a name and set of objects. Block definitions can also contain attribute definitions.</td>
</tr>
<tr>
<td>block reference</td>
<td>A block reference can contain other (nested) blocks. For example, you can insert a drawing of a mechanical assembly that contains a housing, a bracket, and fasteners, with each fastener composed of a bolt, washer, and nut.</td>
</tr>
<tr>
<td>Attribute Object</td>
<td>An object that appears as a text string and describes the characteristics of an attribute reference. This object is called an attribute definition in AutoCAD.</td>
</tr>
<tr>
<td>An attribute</td>
<td>An attribute provides an interactive label or tag for you to attach text to a block. Whenever you insert a block that has a variable attribute, AutoCAD prompts you to enter the data to be stored with the block. Examples of data are part numbers, prices, comments, and owners' names.</td>
</tr>
<tr>
<td>external reference</td>
<td>An external reference (xref) links another drawing to the current drawing. When you insert a drawing as a block, the block definition and all of the associated geometry is stored in the current drawing database.</td>
</tr>
</tbody>
</table>
### Appendix A

**Microsoft Project Scheduling Terms**

#### Table A.2: Glossary for CCS cost estimating Terms

<table>
<thead>
<tr>
<th><strong>Activities</strong></th>
<th><strong>Activities are the tasks or operations that are required to be carried out in the program. Activity information may be created and edited on the screen bar chart, on an activity list or on activity dialog documents</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trade code</strong></td>
<td><strong>A one-digit alpha code to identify a trade. This code may be used to register trades against activities. Only one trade code may be entered against an activity. The trade code is compulsory for all Op Codes. It forms the first digit of a simple Op Code and the second digit of a macro Op Code.</strong></td>
</tr>
<tr>
<td><strong>Total Quantity Billed</strong></td>
<td><strong>The total quantity for an Op Code is the sum of the billed quantities for the items which that Op Code has been used against.</strong></td>
</tr>
<tr>
<td><strong>Op Code</strong></td>
<td><strong>Simple Op Codes take the form of a trade code followed by up to seven further characters. In Candy, every bill item must have an Op Code (Operation Code). It is the Op Code that contains key information including the description and any pricing information. Every Op Code must begin with a previously defined trade code. The trade codes are defined on the trade definition document. The first digit of the Op Code must be a valid trade code. The balance of the code, used against the bill item, may be any alphanumeric combination to create a code no more than a maximum of eight digits in total. The trade code should be a broad categorisation of the different types of items in the bill of quantities. Trade codes may be used in the following processes.</strong></td>
</tr>
<tr>
<td><strong>Op-Code Attributes (Attributes)</strong></td>
<td><strong>Op Codes in Candy can have various attributes, which are displayed in the Op Code, attributes field, headed Attr. This is a four-digit field that may contain up to three different markers.</strong></td>
</tr>
<tr>
<td><strong>Task Code</strong></td>
<td><strong>Task codes are optional eight-digit alphanumeric codes, which may be allocated to Op Codes for the purpose of seeing, grouping or summarising the information that is produced from a bill type report. They may also be used for linking to a SitePlan program.</strong></td>
</tr>
<tr>
<td><strong>Work Code</strong></td>
<td><strong>Work codes are optional eight-digit alphanumeric codes, which may be allocated to Op Codes for the purpose of seeing, grouping or summarising the information that is produced from a bill type report. They may also be used for linking to a SitePlan program.</strong></td>
</tr>
<tr>
<td><strong>Bill Code</strong></td>
<td><strong>Bill codes are optional eight-digit alphanumeric codes, which may be allocated to bill items for the purpose of seeing, grouping or summarising the information that is produced from a bill type report.</strong></td>
</tr>
<tr>
<td><strong>secondary codes</strong></td>
<td><strong>Various secondary codes may be allocated to each activity in the program in order to group and sort them for reporting purposes. The secondary codes that are available in SitePlan are all 8-digit alphanumeric codes, and may be defined before they may be allocated to activities.</strong></td>
</tr>
<tr>
<td><strong>Macro-Op Code</strong></td>
<td><strong>Macro Op Codes take the form of a number, followed by a trade code followed by up to six further characters. Sometimes the client's bill contains composite items. These are items that describe more than one operation or trade, examples of which are manholes or cassions. In Candy, a main bill of quantities may be created for such items using a macro Op Code. Macro Op Codes may be created on the bill writer by combining or imploding simple Op Codes and/or lower level macros from the bill of quantities or an area bill.</strong></td>
</tr>
<tr>
<td><strong>Production Code</strong></td>
<td><strong>Production codes are one-digit alpha codes which may be used for analysing outputs and production by bill item or by task code. They are optional and may be allocated to resources, together with a unit conversion factor, on the basis of one code per resource.</strong></td>
</tr>
<tr>
<td><strong>Resource Type Definitions</strong></td>
<td><strong>If any split of the rate is required, then resource types must be defined. On the resource type definitions document, a resource type is defined by entering a letter in the first field and a description in the second field. Resource type definitions are used as an essential part of a simple resource, and are used to broadly categorise the list of resources into Labour, Plant, Material etc.</strong></td>
</tr>
<tr>
<td><strong>Resource Code</strong></td>
<td><strong>An eight-digit alphanumeric code which is unique to each resource or resource heading. The resource list is automatically sorted on this code.</strong></td>
</tr>
<tr>
<td><strong>Simple resources</strong></td>
<td><strong>Simple resources are the basic building blocks of an estimate. They are the things which are actually required to build the job - examples of which might be bags of cement, m3 of sand, labour paid by the hour or plant hired by the week. Resource type definitions are used as an essential part of a simple resource, and are used to broadly categorise the list of resources into Labour, Plant, Material etc.</strong></td>
</tr>
<tr>
<td><strong>Complex resources</strong></td>
<td><strong>Complex resources are combinations of other resources. For example, every time that you wish to price a concrete item in the bill of quantities, it would be fairly tedious to have to bring the sand, stone and cement into that item, and combine them in the correct proportions. When you have a concrete item to price you have only one resource to bring into that item. Further levels of resource may be introduced to produce a complex chain.</strong></td>
</tr>
<tr>
<td><strong>resource list</strong></td>
<td><strong>The resource list is used to create simple resources by registrating them on the list and allocating each one a type, resource codes, description, unit, rate, etc. Once simple resources exist, they can in turn be used to create complex resources.</strong></td>
</tr>
<tr>
<td><strong>Total Quantity use-of-a resource</strong></td>
<td><strong>This value represents the total use of a resource against each activity to which it has been allocated, and may be calculated in one of three ways, depending on the resource distribution type for the resource. Total type - The resource quantity is the total utilisation for this type of resource for an activity. Rate type - The total utilisation is calculated from the resource quantity x duration. Pool type - The resource quantity is the total utilisation for this type of resource for an activity.</strong></td>
</tr>
</tbody>
</table>

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Table A.2: Glossary for CCS cost estimating Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Rates</td>
<td>Production rates or outputs may be obtained for user defined categories of resources, for either individual bill items or for task codes. Production codes may be combined in order to compile total man hours for inclusion on a bill scroller and on worksheet or dual currency bill reports.</td>
</tr>
<tr>
<td>Cost Per Unit worksheet</td>
<td>Resources may be given a cost per unit that is used when a histogram by value is required. The daily quantity is multiplied by the cost per unit to produce a cost per day. A worksheet is the document on which resources are allocated to an operation, together with production rates, factors, etc, to arrive at a unit rate for the billed item.</td>
</tr>
</tbody>
</table>

| Gross Rate                  | The gross rate is a calculated rate, and is based upon the nett rate plus any markup that has been applied.                                 |
| Nett Rate                   | The nett rate represents the internal value or cost of an item. It may be created using any one of the following methods: plug rate, split rate, worksheet, subcontract rate. |
| Nett-Split Rates            | The nett split rates columns represent the nett rate for an item, broken down into resource types. The value of each resource type is calculated from the contribution of each simple resource type, based upon the use of resources on the worksheet. |
| Plug-Rate Pricing           | The simplest way of pricing in Candy is by using plug rates. Plug rate pricing is best achieved on a bill or Op Code scroller, with the nett rate and attributes columns displayed. As the name implies, this is simply an all up rate entered against an item. It produces value for this bill item in the tender total, however, there is no breakdown of that value whatsoever. |
| Split-Rate Pricing          | The next level of pricing in Candy is to use split rates. Split rate pricing is best achieved on a bill or Op Code scroller, with the nett split rates and attributes columns displayed. |
| Worksheet Pricing           | The most detailed way of pricing in Candy is by using worksheets to prepare a fully detailed analytical estimate.                        |
| Subcontract Rate            | The subcontract rate selector provides the mechanism for pricing Op Codes in subcontract rate mode. Up to 10 subcontractors together with rates and remarks may be listed against any Op Code. |
| Provisional Worksheet       | You may mark any worksheet as being provisional. For example, if you were pricing items in the bill for which you had to supply materials, but you were using a labour only subcontractor to install those materials. Having sent out for labour only quotes, you could price the material element of the applicable worksheets, and mark them as provisional while waiting for the labour only quotes to be received. |
| Markup                      | Markup is the process of enhancing the estimated nett rates in a tender to allow for profit, indirect costs, escalation, risk etc. This marked up rate is termed the gross rate in Candy. |
| Pricing Currency            | When working with multiple currencies, it is advisable to name the pricing currency - that is the currency to which all resources priced in a foreign currency are converted. This would normally be the currency in which a tender is to be submitted. |
| Pricing Mode                | The first position in the attributes (Attr) column indicates the current pricing mode for the Op Code. The following indicators may be displayed in this column. |
| U                           | Unpriced                                                                                                                                    |
| P                           | Plug rate                                                                                                                                   |
| S                           | Split rate                                                                                                                                   |
| W                           | Worksheet                                                                                                                                   |
| w                           | Provisional worksheet                                                                                                                       |
| X                           | Subcontract rate                                                                                                                             |
| 1                           | Unpriced items in a macro worksheet                                                                                                          |
| ?                           | Plug rate items in a macro worksheet                                                                                                         |
| Cost Plan                   | The detailed bill of quantities may be presented in a cost plan format, which breaks down the bill into summary construction elements.    |
| Resource Importers          | If a resource list is available as a file (CSV or ASCII) or a backup file from one of the widely used word-processing or spreadsheet software packages, the resource importer utility in Candy may be used to create the Candy resource list. If a file is not available, a paper copy may be used to generate a suitable file using a scanner, together with an OCR (Optical Character Recognition) software package. The following resource importer methods are available: Delimited files (CSV), ASCII files (Text). |
## Table A.3: Glossary for Microsoft Project Scheduling Terms

<table>
<thead>
<tr>
<th>Schedule</th>
<th>The timing and sequence of tasks within a project. The schedule consists mainly of tasks, dependencies among the tasks, durations, constraints, and time-oriented project information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task</td>
<td>A job that has a beginning and an ending. The completion of a task is important to the project’s completion. Projects are made up of tasks. A task is sometimes referred to as a subtask. Each task in a project has work that must be done.</td>
</tr>
<tr>
<td>Task Dependancy</td>
<td>A task dependency describes how a task is related to the start or finish of another task. Microsoft Project provides four task dependencies you can use to connect a series of tasks in a schedule. By using these dependencies effectively, you can modify the critical path and shorten your project schedule. Slack tasks depend on start and finish time.</td>
</tr>
<tr>
<td>Task dependencies (FS, SS, FP, SF)</td>
<td>The nature of the dependencies between linked tasks. You link tasks by defining a dependency between their start and finish dates. For example, the “Contact caterers” task must finish before the start of the “Determine menu” task. There are four kinds of task dependencies in Microsoft Project. Finish-to-start (FS): The task (B) cannot start until another task (A) finishes. Start-to-start (SS): The task (B) cannot start until another task (A) starts. Finish-to-finish (FP): The task (B) cannot finish until another task (A) finishes. Start-to-finish (SF): The task (B) cannot finish until another task (A) starts.</td>
</tr>
<tr>
<td>Recurring task</td>
<td>A task that occurs repeatedly during the course of a project. You might define the weekly status meeting as a recurring task.</td>
</tr>
<tr>
<td>Lag Time</td>
<td>Lag time delay tasks. A delay between tasks that have a dependency. For example, if you need a two-day delay between the finish of one task and the start of another, you can establish a finish-to-start relationship and specify a two-day lag time. You enter lag time as a positive value relationship.</td>
</tr>
<tr>
<td>Lead time</td>
<td>Overlap tasks. An overlap between tasks that have a dependency. For example, if a task can start when its predecessor is half-finished, you can specify a finish-to-start relationship with a lead-time of 50 percent for the successor task. You enter lead-time as a negative value.</td>
</tr>
<tr>
<td>Predecessor</td>
<td>A task whose start or finish determines the start or finish of another task. A task that must start or finish before another task can start or finish.</td>
</tr>
<tr>
<td>Successor</td>
<td>A task that cannot start or finish until another task starts or finishes. A task that cannot start or finish until another task starts or finishes.</td>
</tr>
<tr>
<td>Early Start</td>
<td>The Early Start field contains the earliest date that a task could possibly begin, based on the early start dates of predecessor and successor tasks, and other constraints. Early Start is calculated as follows: When you first create a task, its early start date is the same as the scheduled start date. As you link the task to predecessors and successors and add any other constraints, Microsoft Project calculates the early start date as the earliest possible date this task could be started, if all predecessor and successor tasks also start on their early start dates. If there is a delay between the task, this is also figured into the early start date.</td>
</tr>
<tr>
<td>Early Finish</td>
<td>The Early Finish field contains the earliest date that a task could possibly finish, based on early finish dates of predecessor and successor tasks, other constraints, and any leveling delay.</td>
</tr>
<tr>
<td>Late Start</td>
<td>The Late Start field contains the latest date that a task can start without delaying the finish of the project. This date is based on the task’s start date, as well as the late start and late finish dates of predecessor and successor tasks, and other constraints.</td>
</tr>
<tr>
<td>Late Finish</td>
<td>The Late Finish field contains the latest date that a task can finish without delaying the finish of the project. This date is based on the task’s late start date, as well as the late start and late finish dates of predecessor and successor tasks, and other constraints.</td>
</tr>
<tr>
<td>Critical task</td>
<td>A task that must be completed on schedule for the project to finish on time. If a critical task is delayed, the project completion date is also delayed. A series of critical tasks makes up a project’s critical path.</td>
</tr>
<tr>
<td>Critical path</td>
<td>The series of tasks that must be completed on schedule for a project to finish on schedule. Each task on the critical path is a critical task. Most tasks in a typical project have some slack and can therefore be delayed a little without affecting the project finish date. Those tasks that cannot be delayed without affecting the project finish date are the critical tasks. As you modify tasks to resolve overallocations or other problems in your schedule, be aware of the critical tasks and that changes to them will affect your project finish date. A task that must be completed on schedule for the project to finish on time. If a critical task is delayed, the project completion date is also delayed. A series of critical tasks makes up a project’s critical path.</td>
</tr>
<tr>
<td>Critical Path Method (CPM)</td>
<td>A project management method of calculating the total duration of a project based on individual task durations and their interdependencies.</td>
</tr>
<tr>
<td>Milestone</td>
<td>A reference point marking a major event in a project, used to monitor the project’s progress. Any task with zero duration is displayed as a milestone.</td>
</tr>
<tr>
<td>Slack</td>
<td>The amount of time a task can slip before it affects another task’s dates or the project finish date. Slack is sometimes referred to as float time.</td>
</tr>
<tr>
<td>Free Slack</td>
<td>The amount of time a task can slip before it delays another task.</td>
</tr>
<tr>
<td>Total Slack</td>
<td>The amount of time a task can slip before it delays the project finish date. When the total slack is negative, the duration for a task is too long for its successor to begin on the date required by its constraint.</td>
</tr>
</tbody>
</table>
Table A.3: Glossary for Microsoft Project Scheduling Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration</strong></td>
<td>The amount of time required completing a task. Elapsed duration includes working and non-working time. A duration value is followed by a time unit abbreviation.</td>
</tr>
<tr>
<td><strong>Working time</strong></td>
<td>Includes working time.</td>
</tr>
<tr>
<td><strong>Elapsed time</strong></td>
<td>Includes non-working time.</td>
</tr>
<tr>
<td><strong>Interim plan</strong></td>
<td>A set of task start and finish dates, and sometimes resource and cost information, that you can save at certain stages of your project. You can compare an interim plan with the baseline plan to monitor project progress or slippage. You can save up to ten interim plans.</td>
</tr>
<tr>
<td><strong>Project calendar</strong></td>
<td>The base calendar used by a project.</td>
</tr>
<tr>
<td><strong>Resource calendar</strong></td>
<td>A calendar that specifies working and non working time for an individual resource. A resource calendar differs from a base calendar, which specifies working and non working time for more than one resource. You can use resource calendars to define unique exceptions for individual resources, such as vacations, different working days, or different shifts.</td>
</tr>
<tr>
<td><strong>Base calendar</strong></td>
<td>A calendar that specifies working and non working time for a project or set of resources. A base calendar differs from a resource calendar, which specifies working and non working time for an individual resource.</td>
</tr>
<tr>
<td><strong>Baseline plan</strong></td>
<td>The original project plan you use to track progress during a project. The baseline plan includes task start and finish dates and resource and cost information.</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>The total scheduled cost for a task, resource, resource assignment, or for an entire project. Sometimes this is also called current cost, or budget.</td>
</tr>
<tr>
<td><strong>Task cost rates</strong></td>
<td>MS Project 98 uses DFD cost estimating procedure to assign cost rates to resource's work: e.g., work items or BoQs or activities are assigned with cost rates that include elements for the people, equipment, and supplies used to complete tasks in a project.</td>
</tr>
<tr>
<td><strong>Fixed cost</strong></td>
<td>A cost that remains constant regardless of the task duration or the work performed by a resource can be assigned to a task. Microsoft Project also allows you to assign rates to resources so you can manage project costs accurately. You can assign multiple standard rates, overtime rates, or per-use rates to resources along with the dates for each rate to go into effect.</td>
</tr>
<tr>
<td><strong>Actual</strong></td>
<td>Information that shows what has actually occurred. For example, the actual start for a task is the day the task started and its actual cost is the amount spent up to the present.</td>
</tr>
<tr>
<td><strong>Resources</strong></td>
<td>The people, equipment, and supplies used to complete tasks in a project. Should include subcontractors who subcontracts a task so fixed cost are assigned to the task. If you don't know which resources have the availability to take on extra work, you can see current resource allocations.</td>
</tr>
<tr>
<td><strong>Resource group</strong></td>
<td>A set of resources that shares some characteristic, categorised by a group name. For example, you can categorise resources by job function and use group names such as plumbers or editors. Or, you can categorise resources by employment status and use group names such as contractors and permanent employees. Enter rates for resource's work on tasks or fixed tasks costs.</td>
</tr>
<tr>
<td><strong>Units</strong></td>
<td>The number of units or the quantity of a resource assigned to a task. For example, if you have a plumbing task, you could assign two units, or two plumbers, to the task. If you have one plumber, you could assign 5 units (half of the plumber's time) to the task. The maximum unit is the maximum number of units available for the resource. For example, if you have three plumbers working on a project, the maximum units is three—three plumbers working full-time. A resource list includes the names of the resources and the maximum number of units as a percentage of each resource's availability.</td>
</tr>
<tr>
<td><strong>Constraint</strong></td>
<td>A restriction or limitation set on the start or finish date of a task. For example, you can specify that a task must start on a particular date or finish no later than a particular date.</td>
</tr>
</tbody>
</table>
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IDEF3 Models of Building, Design, Cost Estimating and Scheduling Processes:

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IDEF3 Model of Overall construction process:
- Process View

Scenario 0 1 Construction Process
IDEF3 Model of Produce and Manage Building Process

Scenario 107 1 Draw up Brief

Scenario 103 1 Produce and Manage Building Process

Scenario 109 1 Draw up Programme
Scenario 110 1 Prepare for Design

Scenario 124 1 Select Designer
Scenario 111 1 Supervise Design

Scenario 112.1 Prepare for Construction

Scenario 113 1 Supervise construction. Take over & Warranty Task
IDEF3 Model for Produce and manage Architectural Design Data Process:

- Process View

Scenario 102 1 Produce and Manage Architectural Design Data

Scenario 113 1 Draw up Brief

Scenario 114 1 Draw up Programme

Scenario 115 1 Make overall Design
Appendix B

Product and manage Architectural Design Process

Scenario 129: Start Building Design

Scenario 130: Design Base Mass Alternatives

Scenario 131: Propose Solutions

Scenario 132: Design Schemes
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Product and manage Architectural Design Process

Scenario 151 Make Scheme Design

Scenario 156 Make General Space Design

Scenario 162 Make Preliminary Space Layout for Main Use

Scenario 163 Design Core Spaces
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Product and manage Architectural Design Process

Scenario 165 1 Determine Spaces for Fire Compartment

Scenario 178 1 Specify Space Boundaries as a Fire Compartment

Scenario 157 1 Make General Facade Design

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Product and manage Architectural Design Process

Scenario 188.1 Make Detail Design

Scenario 192.1 Make Detail Design of Spaces

Scenario 204.1 Make Detail Design of Space Items

Scenario 193.1 Make Detail Design of Facade

Scenario 195.1 Make Detail Design of Roof Structures
Appendix B

Product and manage Architectural Design Process

IDEF3 Model for Produce and manage Architectural Design Data Process:
- Object View
Scenario 102: Produce and manage architectural design data process

IDEF3 Model for Produce and manage Architectural Design Data Process: Object View
Appendix B
Pre-tender Procedure

IDEF3 Model for Pre-tender Procedure: Process View

Scenario 0  Construction Operation

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Scenario 10.1 Build up Complete Estimate
IDEF3 Model for Pre-tender Procedure: 
Object View
Scenario 10: Pre-tender Procedure

IDEF3 Model for Pre-tender Procedure: Object View
IDEF3 Model for Pre-tender Procedure: Object View
IDEF3 Model for Pre-construction Scheduling Process: Process View

Scenario 0  Construction Operation

Scenario 5 1  Identify Scheduling Items

Scenario 9.1  define construction sequences
IDEF3 Model for Pre-Construction Scheduling: Object View
Scenario 2.1 Schedule Construction Operations

IDEF3 Model for Pre-Construction Scheduling: Object View
Scenario 5.1 Identify scheduling items

Scenario 9.1 Define Construction Sequence
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Elaboration Forms for the IDEF3 Process Models

<table>
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<th>Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
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<td>Produce and Manage Building Process</td>
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<td>439</td>
</tr>
<tr>
<td>Pre-construction Scheduling Process Object View</td>
<td></td>
</tr>
</tbody>
</table>
Objects: building process, client, brief, programme, (ARCH, Struct, BS, Geo programmes) design, construction, candidate designer, design disciplines, candidate contractor, project existing/new, company strategy, design team, activities, project brief, building project data; project plan, design schedules, design instructions

Facts: The clients briefing identifies changes in activities of their customers’, the requirement and the possibilities to satisfy the requirements with information contributed from the design discipline (ARCH, Struct, BS, Geo design). The purpose of programming is to lay a foundation for investment decision, the programme includes programmes from the design discipline. The main designer task plays an important role in the establishment of space programme and other requirements. Requirements set during programming concern functional aspects, cost, profitability, schedule, and mode of operation, maintenance and building permits.

In preparation for design, the client organises design, prepares alternatives for choosing of designers, concludes contracts after choosing designers and assembles design instruction and schedules. The main designer gives design instruction during programming stages. In the supervision of design, the clients check, compares and approve design solutions at different stages of the design development process. The client makes the decision and it guarantees in yielding and acceptable design concerning functional, economical, esthetical, as well as environmental aspects. In preparation for construction the client prepares and processes tender invitation for selection of contractors from possible candidates. In the supervision of construction the client checks and ensures the execution of work according to the contract, schedule and budget.

Constraint: the briefing process requires information from statement of clients needs and requirements and company's strategy. Programming requires clients brief and programme from design discipline (ARCH, STUCT, BS, GEO programme). The preparation for design requires prepared programme and design instructions (ARCH programme). Supervision of design requires prepared design and contracts and schedule. Prepare for construction, requires supervised design. Supervision of construction, is constrained by the contract, project schedule, and budget.

Description: white space
### Objects:
Clients' activities, client, activities changes, requirements for activities changes, possibilities and operation alts, design discipline, existing project, new project, brief, design discipline information (ARCH, Struct, BS, Geo design information), clients' project brief, design discipline's project brief.

### Facts:
In the define requirements process, the client defines the requirements and objectives with input from the design discipline (ARCH, Struct, BS, Geo) briefs. Determination of space acquisition alternatives is clients' task to determine on space acquisition alternatives analyse conditions and profitability with input from the design discipline (the ARCH, Struct, BS, and Geo design) The preparation of decision for programme is carried out by the client taking into account the defined requirements and objectives, design discipline's brief, site acquisition alternatives, and risk, susceptibility and trend analysis. Analysis of environmental effects is carried out and requirements for building permit are established.

### Constraint:
The definition of requirements process requires output from the clients' business & facility management process, statement of clients' needs, established clients' needs. Determination of space acquisition alternatives requires clients' statement of needs, defined requirements and objectives, layout drawings, and brief from the design discipline. For the preparation of decision for programme to hold there must be a decision to implement programme.

### Description:
White space
### Context Setting

**REFERENCE:** UoS elaboration

### Item Described

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**Appendix C**

Produce and Manage Building Process  Process View

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**UoB NO**

UoB Name: draw up programme

UoB label: draw up programme

**Objects:** programme, investment decision, requirements, main design, client, design discipline, client's activities and facility management/ project schedule/ mode of operation, ...

**Facts:** the definition of requirements imposed by the activities and facility management carried out by the client, includes, describing of activities and their objectives, space management, profitability, life cycle and ecological objectives, and maintenance programme. Dimensional requirements, Space programmes, scope objectives and other requirements, are established by the client with input or major work from the main designer (space programme, ARCH & INT) The client clears building site and procedures for building permit with information from the Geo analysis, city plan (AUTH), local planning/zoning (AUTH) and ownership (AUTH) During the planning of schedule and mode operation, The client organises design, construction and mode of operation and produces project schedule. The client sets cost objectives and clears up financing, profitability and budget. The client assembles the programme and prepares investment decision

**Constraint:** definition of requirements imposed by the activities and facility management requires clients brief. Space programming requires description of requirements and clients brief. Clearing building site and procedures for building permit requires clients brief. The planning of schedule and mode operation requires clients brief and description of cleared building site and procedures for building permit. The cost objective setting and clearing up of finance, profitability and budget requires clients brief, space programme, requirements and scope and objectives. For the preparation of investment decision there must be an investment decision, defined requirements, space programme, description of building site information and procedures for building permit, project schedule and cost objectives and finance profit and budget

**Description:** white space
UoB No: 109

UoB Name: prepare for design

UoB label: prepare for design

Objects: design, designer, design contract, client, design schedule, design instruction, tender,

Facts: the designer organises design work with input from the ARH design schedule. Selection of designers from possible candidates of designers may be made in several different ways such as direct selection, negotiation, tender-based selection, or competition. The client decides on the selection method based on the organised design and candidate designers. The client and the selected designers conclude the design contract.

Constraint: the organisation of design work requires a programme. For the selection of designers there must be an organised design work. For the contract to be concluded, there must be selected designers and a decision on the contract.

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**Produce and Manage Building Process: Process View**

**UoB Name:** supervise design  
**UoB label:** supervise design

**Objects:** design, design solutions, design stages, clients, designers, prepared design.

**Facts:** Design process starts with minutes of start meeting regarding design instructions, minutes of agreed procedures and agreed design schedules between the client and designer. In controlling and supervising of design process the client compares, checks and approve/make decision on design solutions at different stages of design development process. The decision ensures/guarantees the production of acceptable design concerning functional, economical, esthetical, technical and environmental aspects. The client and may be the designers compare design solutions form users, profitability, cash flow perspectives and hold memos of comparison and explanations. The client checks and evaluates design solutions against objectives and requirements. This involves inspections of design, estimating building parts, and presentation of foundation for approval of design. The client obtains design approval of design solutions and document decisions. The client controls acquisition of permits and estimation of environmental effects.

**Constraint:** The start of design process requires prepared design. Controlling and supervising design solutions requires prepared design, specified design instructions, agreed procedures and agreed design schedule. Comparison of design solutions requires prepared design, start of design, supervised design solutions and decision on design solutions. The checks and evaluates and evaluation of design solutions requires prepared design, start of design and design solutions. Obtaining of design approval requires start of design and decision on approved design solutions. Control acquisition of permit requires decisions on approved design solutions and environmental effects estimate.

**Description:** white space
**UoB NO**

**UoB Name:** prepare for construction  
**UoB label:** prepare for construction

**Objects:** tender, invitation to tender, mode of operation, contractors, contracts, client,

**Facts:** The client selects the mode of operation based on the supervised design  
The client prepares contract programs, requirements of contract programme concerning schedule, blank sheets, bills of quantities, scope of contract appendices, technical documents, work safety programme for invitation to tender  
The client prepares list of contractors, invitation to tender, makes announcements, prepare additional requirements, cost estimates, minutes of tender opening, meeting memos and comparison of tenders for selection of contractors  
The client makes decisions on construction based on the tender received and compared  
The contractor and client conclude the contract based on the mode of operation  
The client manages procurement (invitation to tender, tenders, orders and contracts) based on the contract.

**Constraint:** The preparation of invitation to tender requires supervised design and mode of operation. The preparation for selection contractors requires prepared invitation to tender and possible candidate contractors. For construction decision there must be construction decision. The concluding of contract requires prepared invitation to tender, invitation to tender, and construction decision. For the management of procurement requires there must be a contract

**Description:** white space
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<tr>
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<th>UoB label: Supervise construction</th>
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<tr>
<td>NO</td>
<td>Objects: Construction stage, contract, project schedule,</td>
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<tr>
<td>112</td>
<td>Facts: The client controls and supervises construction to ensure the execution of construction according to the contract and project schedule. The client supervises subcontracting and approves selected subcontractors and equipments. The client manages payments (financing schedule, budget reports, invoices) based on bills. The client carries out additional work and modifications based on the need for additional work or modification from/on the client’s work. The client manages acquisition of builder and special cases based on the prepared construction.</td>
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**CONTEXT SETTING**

**ITEM DESCRIBED:**

**REFERENCE:**

**FORM TYPE:**
UoB elaboration
Objects: Main designers (may be a team of representatives from various design disciplines), architect, design, brief, programme, global design (overall design), detail design, design during construction and during use and maintenance, task during handover, client’s need, architectural data.

Facts: Briefing involves collection of basic information needs, requirements and possibilities from the client. IFCs. Briefing and programming involve complementing the client’s project brief and programme with architectural point of view to assist in the definition of the client’s need. Briefing and programming activities are carried out by the main designer and gets input from the client work (client’s brief and programme). The client usually carries out programming with assistance from the main designer. The overall design involves producing design, sufficient for building permit, based on the architectural programme and design instructions. Detail design involves elaboration of the overall design until sufficient accuracy is achieved for invitation to tender. Design during construction is carried out based on the procurement contract.

Constraint: The briefing requires statement of client’s needs. The programming activity requires architectural brief and clients brief. The overall design activity requires programme from client and architectural programme. The detail design activity requires approved cost objectives, building permit, checked design instructions, and approved overall design form other disciplines (STR, BS, GEO, INT) design activity during construction requires detailed design.

Description: White space
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<td>UoB 113</td>
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</table>

**Objects:**

Analysis of the present situation involves study of the activities and existing premises by the main designer based on the existing premises and activities.

**Facts:**

Definition requirement involves defining strategic alternatives, possibilities, dimensional requirements, location criteria, site requirements, economical requirements, and schedule goals.

**Constraint:**

Determination of space acquisition alternatives involves space acquisitions alternatives and location alternatives and comparisons.

The preparation of programme decision is carried out by the main designer based on the inventory of activities and existing premises, defined requirements and determined space acquisition alternatives.

**Description:**

White space
The definition of requirements set by the activities and facility management involves definition of design instructions, lifecycle principles, and profitability and maintenance requirements.

The drawing up of space programme and requirements involves drawing space programmes (room programmes, diagrams, areas, volumes, special requirements and connectivity diagrams) based on space programme (INT).

Clearing site and building permit involves clearing the maintenance requirements, technical constructability, juridical constructability, local plan acceptability and environmental effects based on the geotechnical analysis (Geo), City plan (AUTH), Ownership (ATUH), and Local planning (AUTH).

Planning schedule and mode of operation involves analysis of economic trend, project schedule (total schedule) production, and mode of operation (design limits).

The setting of cost objectives and clearing financing, profitability and budget involves identification of cost objectives, activity costs analysis, financing plan, tenancy estimate, profitability and budget analysis based on the defined requirements set by activities and facilitate management.

The preparation of the investment decision is carried out based on the defined requirements, space programmes and special requirements, cleared site and building permits, planned schedule and mode of operation and cost objectives and financing, profitability and budget.

The definition of requirements set by the activities and facility management requires analysis of present situation.

The drawing up of space programme and requirements requires defined requirements and analysis of present situation.

Clearing site and building permit requires location criteria and sit requirements.

Planning schedule and mode of operation requires preliminary schedule and cleared site and building permits.

The setting of cost objectives and clearing financing, profitability and budget requires cost objectives, space programmes and special requirements and planned schedules and mode of operation.

Description: White space.
## UoB Name: Make Over all Design

### Objects:
- Starting building design involves the main designer's task based on design instructions.
- Design of basic mass alternatives involves studying massing of building by the main architect.
- The proposal of solutions is carried out by the main architect based on the chosen basic mass alternatives.
- Design of schemes involves preparing and submitting an application for a building permit.

### Facts:
- Starting building design requires architectural programme.
- Design of basic mass alternatives requires checked design instructions and decision on basic solutions.
- The proposal of solutions requires checked design instructions and decision on proposed solution.
- Design of schemes involves requires checked design instruction and scheme decision.

### Constraint:
- White space
UoB Name: Start Building Design

Objects:

Facts:
Checking the design responsibilities involves the main designer's task.
Planning the design schedule involves the main designer's activity based on the design schedule from the client.
The checked result of the site map (AUTH), geotechnical information (Geo), Drawing of existing building, municipal engineering (AUTH), and state of real estate (AUTH) are used as a control in the specification of special requirements and needs and checking of design objectives.
The specification of special requirements and needs involves the main designer's task based on the user information.
Checking the design objectives involves the main designer's task based on the special requirements and needs of users.
The start of design work involves the production of design instructions based on the checked design responsibilities, design schedules, checked site and site (AUTH) information, user's special requirements and needs and checked design objectives.

Constraint:
Start Building Design requires architectural programme.
Checking of design responsibilities requires task lists and architectural programme.
Planning the design schedule requires checked design responsibilities and architectural programme.
Checking process of site map (AUTH), geotechnical information (Geo), Drawing of existing building, municipal engineering (AUTH), and state of real estate (AUTH) requires architectural programme.
Specification of special requirements and needs requires architectural programme, design schedule and checked site and AUTH information.
The start of design work requires architectural programme.

Description: White space
## Design Basic Alternatives

**Objects:**

The design of basic mass alternatives starts with designing of alternatives for site usage and the approved site usage design is elaborated on further to design alternative basic solutions. Design of basic mass alternatives involves preliminary definition of the external shell, shape and volume based on the site usage alternatives. Estimating, scope, efficiency and costs involve analysis of the scope, efficiency and cost effects of the initial mass design based on the mass alternatives (by the QS). Analysis of environmental effects involves study and comparison of the alternative solutions for environment effects based on the basic mass alternatives and estimated scope, efficiency and cost. Alternative solutions are presented to the client for further design decision based on the site usage alternatives, basic mass alternatives, estimated scope, efficiency and cost of the solutions and environmental effects of the solutions.

**Constraint:**

The process of design alternatives for site usage is controlled by the client and requires layout drawing and decision on site usage alternative. Presenting the solution to client for decision requires decision on basic solutions.

**Description:**

White space
**Appendix C**  
*Produce and manage Architectural Design Data Process Process View*

<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Propose Solution</th>
<th>UoB label: Propose Solution</th>
</tr>
</thead>
</table>

**Objects:**

The checking of input documents involves studying of the basic solution based on the mass alternatives produced and preliminary layout of drawing process proceeds based on the checked documents, and basic mass solutions.

The definition of the principal architectural and technical solutions depicts the process of the solutions based on the checked documents, chosen site mass alternative, proposed solutions from other design team (STR, BS, GEO, INT).

Assembly of the general information of proposed solution involves data collection on the architectural and structural aspects, scope, efficiency, and space group comparison and cost estimate vs objectives of the proposed solution based on the checked documents and principal architectural and technical solutions.

Preparation of application for exceptional permits and getting advance opinions involves based on the general report on the proposed solution, preliminary layout drawing and advance opinions (AUTH).

Presenting of solution for further design and co-ordination of design work involves organising and proposing solution for further design decision based on the advance opinions and exceptional permits, general report on the proposed solution, preliminary layout drawing and proposed solution from the design team (STR, BS, GEO, INT).

**Constraint:**

The definition of the principal architectural and technical solutions requires preliminary layout drawing and objective of programme.

The client controls preparation of application for exceptional permits.

Presenting of solution for further design and co-ordination of design work requires decision on proposed solutions.

**Description:**

White space

**CONTEXT SETTING REFERENCE:**

**ITEMD DESCRIBED:**

| FORM TYPE: |
| UoB elaboration |
The design schemes start with estimation of feedback from the proposed solution and making layout drawing and environmental plan based on the proposed solution and feedback from the client. The scheme design involves general design of spaces, façade, repetitive units, fittings, layout drawing, elevations, and essential sections based on the general layout drawing and environmental plan. Review of the technical systems and checking of the compatibility of designs involves the main designers task based on the scheme design from the architect and schemes from other design teams (schemes, STR, BS, GEO, and INT). Preparation of general description involves description of construction method and general description of architectural and structural solutions calculation concerning permitted building volume and area, information involving space group based comparison and comparison of cost and design objectives with requirements based on the technical systems and compatibility and description of construction method (STR). Tasks concerning building permits involve submitting application for building permit based on the prepared general description. The decision for further design involves the client’s task based on the general layout drawing and environmental plan, scheme design, technical systems and compatibility and the prepared general description of the scheme design.

Constraint: Scheme design requires briefing of feedback.
The client controls tasks concerning building permits.
The decision for further design requires scheme decision.

Description: White space
The general space design involves determination and layout of preliminary spaces based on a space (building) programme, creating of core spaces, circulation and fire compartments spaces based on the building programme requirement.

The general façade design involves determination of the initial building massing based on the floor plates created during the preliminary space lay out, determination of the façade-structures relationship based on the effect the designer want to achieve. Determination of fenestration based on the amount of light and visual impact of the glass and opening on the façade. Determination of generic façade and roof material of construction based on the regional style and culture, climate, client’s desire, durability, regional construction methods, ease of use, cost and availability and generic design of adornment based on the based on the clients desire and regional location. General design of repetitive units and fittings involve definition of required repetitive units and fittings based on the requirement and layout drawing of locations based on the function. General design of essential sections involves graphical representation of essential sections for more detailed information of the scheme design based on the level of detail required.

The general lay out drawing provides general graphical information on the design.

Constraint:
- general space design
- The general façade design
- General design of repetitive units and fittings
- general lay out drawing

Description: White space
## Objects:

The general space design starts with a preliminary space layout from space programme. The preliminary space layout task involves generating spaces, from building programme, definition of floor and organisation of the spaces into the floor, determination of space depths (dimensions) and circulation path around them and checking space layout against the programme. The task includes determination of dimensions, shape and locations of the spaces.

Design and determination of core and circulation spaces activities is balance between making available ancillary spaces and programme requirements. The task involves determination of core and circulation spaces requirements based on the programme requirements and determination of dimensions and location on the floor based on the type and size of items required in the spaces and programme requirements, structural systems, and occupants. Determination of fire compartment spaces involves subdividing the building into compartments enclosing by fire resisting construction to limit spread of fire and provide means of escape.

## Constraint:

The preliminary space layout activity is constrained by the information defined in the building or space programme. The design and determination of core and circulation spaces is constrained by relevant code. Determination of fire compartment spaces is constrained by fire regulation governing the maximum distance for fire use and sprinkler systems provision.

## Description:

White space

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### CONTEXT SETTING REFERENCE:

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<th>UoB NO</th>
<th>UoB Name: Make General Space Design</th>
<th>UoB label: Make General Space Design</th>
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### ITEM DESCRIPTION:

- **Objects:**
  - The general space design starts with a preliminary space layout from space programme. The preliminary space layout task involves generating spaces, from building programme, definition of floor and organisation of the spaces into the floor, determination of space depths (dimensions) and circulation path around them and checking space layout against the programme. The task includes determination of dimensions, shape and locations of the spaces.
  - Design and determination of core and circulation spaces activities is balance between making available ancillary spaces and programme requirements. The task involves determination of core and circulation spaces requirements based on the programme requirements and determination of dimensions and location on the floor based on the type and size of items required in the spaces and programme requirements, structural systems, and occupants. Determination of fire compartment spaces involves subdividing the building into compartments enclosing by fire resisting construction to limit spread of fire and provide means of escape.

- **Constraint:**
  - The preliminary space layout activity is constrained by the information defined in the building or space programme. The design and determination of core and circulation spaces is constrained by relevant code. Determination of fire compartment spaces is constrained by fire regulation governing the maximum distance for fire use and sprinkler systems provision.

- **Description:**
  - White space

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**FORM TYPE:**

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Objects:

Facts: The general façade design starts with building massing. Massing involves definition of volume and shape of the building based on the floor plates created during space layout and floor to floor height of each interior spaces and proposed mass solution and determination of fenestration, cladding materials and detail of adornment of the facade.

The determination of façade-structures relationship involves determination of construction method at the intersection between façade and structure based on the effect the designer wants to achieve.

Design and determination of fenestration involves designing opening to spaces and determination of complimentary structures to the openings based on the amount of light and visual impact of the opening and complimentary structures on the façade in the design of opening and complimentary structures size and shape of the openings and material of the complimentary structures is identified.

Constraint: Determination of material of construction and design of adornment is carried out based on the regional style, culture, client's desire, durability, regional construction method, cost, availability and ease of use.

The building massing process is constrained by the regional height restrictions and briefing of feed back on proposes solution.

The determination of façade-structures relationship requires information of materials used.

Design and determination of fenestration requires information concerning orientation of the face where the fenestration is located and briefing of feed back from the proposes solution.

Determination of material of construction and design of adornment is constrained by the style.

Description:

White space

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<td>UoB elaboration</td>
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<td>REFERENCE:</td>
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Objects:

Facts: The detail design starts with an evaluation of the overall design based on the overall design and the evaluation is used as a control for further design. Detail design involves elaboration of the design until sufficient accuracy is achieved for invitation to tender based on the overall design from ARCH-design, STR-design, and BS-design. The checking of compatibility of detail design involves the main designers task based on the detailed design of the team (ARCH), BS-designs and STR-designs. Additional tasks involve assistance by the QS or main architect in preparation of invitation to tender and analysis of tender and includes design of movable pieces of furniture, landscape, guidance systems and signs based on the detail design, components supplier design ad tender (contractor) Design for production involves production of specialised detailed design, according to the contractors specific instruction, based on the detail design, description of compatibility of detail design and the complimentary designs of for production.

Constraint: Detail design requires evaluated overall design and proposed changes to design. The checking of compatibility of detail design requires proposed changes to design. Additional tasks require proposed changes to design. Design for production requires proposed changes to design.

Description: White space
The detail design process starts with detailing of the spaces and façade design, roof structures and continues to further detail until sufficient accuracy is achieved for production information and concludes the process with preparation of construction specification.

The detail design of space involves further elaboration of the spaces created during the scheme design, and design of partition structures, internal openings and their complimentary structures, items and fittings on spaces and space floor structures (where applicable) based on the overall design scheme design.

The detail design of façade involves further elaboration of the façade and external projecting structural elements of the external shell, complimentary structures to external openings and detail of adornments designed in the scheme design based on the overall design.

The assistance in the design of structural frame and foundation involves provision of information for the design of the external structures and foundations.

The detail design of roof structures involves final determination of, roof type, shape, and material of construction, detailing design of the skylight, and design of drainage.

Detail design of surface structures and finishes involves determination of material of construction for the surface based on the proposed design in the scheme design and client’s feedback.

Preparation of construction specification involves based on the detail design of the project.

The detail design of space
The detail design of façade
The assistance in the design of structural frame and foundation is controlled by the layout drawing and detail design of space and façade.

The detail design of roof structure is controlled by the design of space and façade, and external structure and foundations.

Detail design of surface structures and finishes, are constrained by regional style and culture of the area.

White space
### Facts

The detail design of space starts with delineation of the defined spaces indicating the existence of physical separation using standard lines based on the programme requirement and information available at the point. Determination of partition types involves definition of partition structural types and material of construction and dimensions based on the building programme requirement.

The layout of partition structures involves elaboration of the partition types determined by graphical representation on the floor that details the type of structure.

Egress analysis is examination of code to determine the distance between the enclosed space and the location of the proposed exit. If required the partition layout can be adjusted to meet the requirements of applicable codes.

Determination and layout of openings to spaces and complementary structures depicts the process of defining internal circulation patterns by placing a break to create opening in the internal enclosing structures. This activity involves determination of dimension and location of the opening and selection of generic type and material for complimentary structure.

Designation of spaces, partition structures and complimentary structures or openings is the process of attachment of some text annotations for reference to details and schedule of the elements.

Detail detailing partition structures involves elaboration and delineation of the partition structures by graphical sections that detail the assembly, material of construction, and dimensions and other properties such as fire rates.

Detailing the complimentary structures involves determination of type, size, material, finish of the complimentary structure based on the environment and building programme requirement, and the functional operations and location of the complimentary structures based on the relationship of the complimentary structures with other building objects.

The task includes definition of a tabular scheduling, for the complimentary structures that display attributes type, dimension, material of construction, finish etc.

Detail design of the items and fitting on the spaces depicts the process detailing the items defined, during the general space design for determination of space size, based on the discipline concerned with item on space.

Detail design of space floors structures is a process of elaborating the material of construction and surface structures and finishes.

### Constraint: Description

| White space | White space |

### Item Described:

- Make Detail Design of Spaces: UoB label: Make Detail Design of Spaces
**Appendix C**

**Produce and manage Architectural Design Data Process View**

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<td>Facts:</td>
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<td></td>
<td>Detail design of the façade depicts the process of elaboration and delineating the external shell and external (projecting) structures by graphical sections that detail the assembly, material of construction, dimensions and other properties and attributes such as fire rates of the shell. Based on the proposed overall design, Detail design of the complimentary structures to external shell opening involves determination of type, size, material, and finish of the complimentary structures, based on the environmental conditions and building programme requirement and external shell. The functional operations and location of the complimentary structures based on the relationship of the complimentary structures with other building objects. The task includes definition of a tabular scheduling, for the complimentary structures that display attributes type, dimension, material of construction, finish etc. The detail design of the adornment involves elaboration of the material-of-construction for façade (external shell) and external structure decoration based on the proposed solution and regional style.</td>
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<td>UoB elaboration</td>
<td></td>
</tr>
<tr>
<td>REFERENCE</td>
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</tr>
</tbody>
</table>

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## Objects:

**Facts:**
The roof design process involves determination and selection of roof type and material of construction based on the form required, and functions of the building and space below, and types of services supported. Decision on the style and shape based on the client’s desire, space programme requirements, regional style and climate, needs to enclose building services, the type of material used and the impact on the building form, and size of projection through the roof items. Integration of skylight or roof windows involves determination, layout and locations of roof windows based on the amount of light required, the impact on the building form it can have. The layout of services process determines spaces required based on the space programme requirements and projections such as vents, stairs, elevators, telecommunications, that need enclosing structures based on the size and type of the projections. The layout of services may change the roof type, shape, and layout of windows.

Design of drainage involves designing snow and water-shedding systems based on the roof planes, slopes, regional climate and selection of size and type of systems material and material. Detailing the roof structures involves elaboration of the roof structure-mass (roof-façade) intersection, roof structure-skylight window intersection based on the shape of the roof, detailing systems for keeping moisture out and detail design of intersection and assembly of roof structural elements and material of construction.

## Constraint:

- White space

## Description:

- White space
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<thead>
<tr>
<th>OBJECT STATE NO.</th>
<th>OBJECT STATE NAME:</th>
<th>LABEL:</th>
</tr>
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<tbody>
<tr>
<td>OS 1</td>
<td>Client's need</td>
<td>Client's brief</td>
</tr>
</tbody>
</table>

**Transition From Object State:**
Architectural brief

**Transition To Object State(s):**
Architectural brief

**Facts:**
Client's brief includes client's activities and change in client's activities, existing premises, client's strategy, requirements, space alternatives, and decision to programme.

**Constraints:**

- **State Condition:** The client's brief must have defined requirements and space acquisition alternatives.
- **Exit Condition:** The client's brief must lead to a project and there must be a decision to programme.
- **Other:**
As a need for a space, facility or for change of activity arises from a client, the client briefs an architect or rep consultant and so the architect prepares architectural brief for definition of the client's need.
### Produce and manage Architectural Design Data Process Object View

<table>
<thead>
<tr>
<th>DATE AT.</th>
<th>ANALYST. Genet Tesfagaber</th>
<th>PROJECT:</th>
<th>date</th>
<th>WORKING</th>
<th>REVIEWER:</th>
<th>DATE:</th>
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<tr>
<th>Object State No.</th>
<th>Object State Name: Architecture</th>
<th>Label: Archi brief</th>
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<tbody>
<tr>
<td>OS 2</td>
<td>Transition From Object State: Client's brief</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transition To Object State(s): Architectural programme</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facts: Architectural brief includes analysed inventory of activities and existing premises, requirements, space acquisition alternatives and programme decision</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constraints:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>State Condition: The architect must have analysed existing premises and activities and define the requirements and space acquisition alternatives</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exit Condition: The architectural brief requires appraisal from the clients or client's feedback brief and the architect must prepare programme decision</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description: As, the architect prepared the architectural brief, the client checks and approves or makes decision on the brief. One decision is made on the architectural brief the architect prepares programme decision</td>
<td></td>
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<thead>
<tr>
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<td>Architectural brief</td>
<td>Object State Elaboration</td>
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<tr>
<td>Scenario 1021</td>
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<tr>
<th>Object State No.</th>
<th>Object State Name:</th>
<th>Label:</th>
<th>Transition From Object State</th>
<th>Transition To Object State(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS 3</td>
<td>Architectural programme</td>
<td>Archit programme</td>
<td>Architectural brief</td>
<td>Over all design</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facts:</th>
<th>The architectural programme includes space programme, and other requirements concerning, functional, cost, profit, schedule, mode of operation, maintenance and building permit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints:</td>
<td>State Condition:</td>
</tr>
<tr>
<td>Exit Condition:</td>
<td>The architectural programme requires approval and feedback brief from the client. The architect must prepare investment decision</td>
</tr>
<tr>
<td>Other:</td>
<td>Description:</td>
</tr>
</tbody>
</table>

CONTEXT SETTING: ITEM DESCRIBED: FORM TYPE:
REFERENCE: Architectural programme | Scenario 102 | Object State Elaboration |
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<th>NOTES</th>
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<table>
<thead>
<tr>
<th>Object State No.</th>
<th>Object State Name: Overall design</th>
<th>Label: Overall design</th>
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<table>
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<tr>
<th>Transition From Object State</th>
<th>Transition To Object State(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural programme</td>
<td>Detailed design</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facts:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The overall design includes outline specification of the client’s need and mass design of the facility and scheme design.</td>
<td>Upon receipt of feedback brief on proposed solutions, the architect elaborated the scheme.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONSTRAINTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Condition:</td>
</tr>
<tr>
<td>The architect must have prepared alternative basic mass solutions and proposed a solution based on the alternatives. The client must approve different design solutions and the scheme must be elaborated. And the main designer to control further design must check design instruction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exit Condition:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The overall design, mass alternatives and scheme design require inspection from the main designer and client’s approval. The overall design must be evaluated for further design activity control.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>OTHER:</th>
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<th>CONTEXT SETTING</th>
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<tbody>
<tr>
<td>REFERENCE:</td>
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<tr>
<td>Scenario 1821</td>
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<table>
<thead>
<tr>
<th>ITEM DESCRIBED.</th>
<th>FORM TYPE.</th>
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<tr>
<td>Overall design</td>
<td>Object State Elaboration</td>
</tr>
<tr>
<td>Object State No.</td>
<td>Object State Name:</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td>Label:</td>
</tr>
<tr>
<td>OS 5</td>
<td>Transition From Object State</td>
</tr>
<tr>
<td></td>
<td>Transition To Object State(s):</td>
</tr>
<tr>
<td>Facts:</td>
<td>The detailed design includes a further elaboration of the over all design, these are spaces, space enclosing structure, complimentary structures and structures and items on spaces</td>
</tr>
<tr>
<td>Constraints:</td>
<td>State Condition:</td>
</tr>
<tr>
<td></td>
<td>Exit Condition:</td>
</tr>
<tr>
<td></td>
<td>Other:</td>
</tr>
<tr>
<td>Description:</td>
<td>The architect elaborates detail design until sufficient accuracy is achieved for invitation to tender. A chosen contractor approves the design or requires modification and corrections. The chosen contractor may require a specialised detailed design to be done according to his instruction</td>
</tr>
</tbody>
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**CONTEXT SETTING**

**REFERENCE:**
Scenario 102.1

**ITEM DESCRIBED:**
Detail design

**FORM TYPE:**
Object State Elaboration
### OBJECT VIEW

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<tr>
<th>OS 6</th>
<th>Object State Name:</th>
<th>Design during construction</th>
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<tbody>
<tr>
<td></td>
<td>Label:</td>
<td>Design during construction</td>
</tr>
</tbody>
</table>

#### Transition From Object State

- **Detail design**

#### Transition To Object State(s):

- Tasks during use and maintenance

#### Facts:

- Design during construction mainly consists of supervision and inspection

#### Constraints:

- **State Condition:** There must be an architect or consultant and a detailed design for the design during construction
- **Exit Condition:** There must be a take over decision made

#### Other:

- Architects and/or consultants supervise and inspect construction work based on the detailed design prepared for the production to ensure production work according to the design

<table>
<thead>
<tr>
<th>CONTEXT SETTING</th>
<th>ITEM DESCRIBED</th>
<th>FORM TYPE</th>
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<td>Design during construction</td>
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### Object State No. OS 7

<table>
<thead>
<tr>
<th>Object State Name:</th>
<th>Task during use and maintenance</th>
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<tbody>
<tr>
<td>Label:</td>
<td>Task during use and maintenance</td>
</tr>
<tr>
<td>Transition From Object State</td>
<td>Design during construction</td>
</tr>
<tr>
<td>Transition To Object State(s):</td>
<td>--------------------</td>
</tr>
<tr>
<td>Facts:</td>
<td>Task during use and maintenance includes warranty inspections</td>
</tr>
<tr>
<td>Constraints:</td>
<td>Checking the usage and maintenance plan as well as planning the guidance and archiving of the design document is required</td>
</tr>
<tr>
<td>Exit Condition:</td>
<td>Task during use and maintenance requires warranty release</td>
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<tr>
<td>Other:</td>
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**Description:**

**CONTEXT SETTING** Item Described: Task during use and maintenance

**REFERENCE** Scenario 102.1

**FORM TYPE** Object State Elaboration
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<tr>
<td>OS 1</td>
<td>Space programme</td>
<td>Space programme</td>
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<table>
<thead>
<tr>
<th>Transition From Object</th>
<th>Architectural brief (scenario 102.1)</th>
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</thead>
<tbody>
<tr>
<td>Transition To Object</td>
<td>General space design</td>
</tr>
<tr>
<td>State(s):</td>
<td></td>
</tr>
</tbody>
</table>

**Facts:**
The architectural space programme defines/includes, room programme, area, volume, space areas, and counts of spaces contained in a group and % age increase allowance for space area. Spaces are defined either as a total square spaces or in dimensions.

**Constraints:**
- **State Condition:** The space programme must state the spaces dimensions and counts and the percentage allowed for increase in to the space control
- **Exit Condition:** The architectural space programme requires client’s approval. The space programme is the basis for space design

**Other:**

**Description:**
Space programme is prepared by the main designer with input from the client’s programme, space programme refines evaluation and check by the client.
Object State Name: General space design
Label: 
Transition From Object State: Space programme
Transition To Object State(s): Enclosed

Facts: General space design includes spaces generated from the programme and based on the programme requirement, these are programmed spaces and supporting spaces core and circulation spaces.

Constraints:
State Condition: The space design must include information such as the shape, dimensions, location and count of the spaces generated including the layout and organisation of the spaces.

Exit Condition: The general space design requires inspection and approval from the main designer and client. The spaces generated and organised require enclosing structures.

Other:

Description: The spaces generated from a building programme are for the main use purpose spaces and the spaces based on building programme requirements are supporting spaces to the main use spaces. The supporting spaces include for circulation spaces, elevators stairs and paths, ways, and for core spaces; rest room spaces, telecommunication services spaces and other services spaces required for the main use spaces.

CONTEXT SETTING ITEM DESCRIBED:
REFERENCE: General space design
Scenario 1511
FORM TYPE: Object State Elaboration
### Object State:

<table>
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<tr>
<th>Object State No.</th>
<th>OS 3</th>
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</table>

#### Object State Name:
Spaces enclosed

#### Label:
Spaces enclosed

#### Transition From Object State:
General space design

#### Transition To Object State(s):
Spaces visually and physically accessed

#### Facts:
Spaces enclosed consist of spaces and enclosing structures. The enclosing structures include external shell (façade), initial structural grid and roof structure. Spaces enclosed provide the mass of the building.

#### Constraints:
- **State Condition:** The enclosed structure must provide dimensional information, volume including area of the building and material of construction for the enclosing structures.
- **Exit Condition:** The enclosed spaces require opening for visual and physical access. And require approval and inspection from the main designer and client.
- **Other:**

#### Description:
Enclosing structures are external shell or wall for external enclosing purpose only. The initial structural grid information is given in relation with the external shell.

---

**context setting reference:**
Scenario 1511

**item described:**
Spaces enclosed

**form type:**
Object State Elaboration
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<th>Object State Name:</th>
<th>Spaces accessed visually and physically</th>
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<tr>
<td>Label:</td>
<td>Spaces accessed visually and physically</td>
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<tr>
<td>Transition From Object State</td>
<td>Spaces enclosed</td>
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<tr>
<td>Transition To Object State(s):</td>
<td>Detail design (scenario189)</td>
</tr>
<tr>
<td>Facts:</td>
<td>Accessed spaces include external openings on enclosing structures including external shell openings and roof openings</td>
</tr>
<tr>
<td>Constraints:</td>
<td>The spaces accessed must provide information, the dimension, shape location, counts of the openings and material for complimenting the openings</td>
</tr>
<tr>
<td>Exit Condition:</td>
<td>The accessed spaces require inspection and approval from the main designer and client. The accessed spaces require complimentary structures.</td>
</tr>
<tr>
<td>Other:</td>
<td>Accessed spaces are space design with the accesses located and dimensioned on their enclosing structures. Complimentary structures are including doors, windows, roof windows etc.</td>
</tr>
<tr>
<td>CONTEXT SETTING:</td>
<td>ITEM DESCRIBED: Spaces accessed visually and physically</td>
</tr>
<tr>
<td>REFERENCE:</td>
<td>FORM TYPE: Object State Elaboration</td>
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### Object State Elaboration

**Object State Name:** Scheme design  
**Label:** Scheme design  
**Transition From Object State:** Architectural programme (scenario 102 1)  
**Transition To Object State(s):** Space detail design  
**Facts:** Scheme design includes general design of spaces, facades, repetitive units, fittings, layout drawings, elevations, essential sections and general description design method of construction  
**Constraints:**  
**State Condition:** The scheme design must provide the general design information the dimensional information of the designed items, material and method of construction and general description on the method of construction  
**Exit Condition:** The scheme design requires approval and inspection from the main designer and client. The scheme design requires further elaboration and detailing.  
**Other:**  
**Description:**

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<tr>
<td>Transition From Object State:</td>
<td>Scheme design</td>
</tr>
<tr>
<td>Transition To Object State(s):</td>
<td>Façade detailed design</td>
</tr>
<tr>
<td>Facts:</td>
<td>Detailed space design includes items and structures on spaces, space floor plates, and internal partition structures, their openings and complimentary structures.</td>
</tr>
<tr>
<td>Constraints:</td>
<td>The detailed space design must include elaboration of the partition structures, the items on spaces, and space floor plates including their locations, dimensional information and material and method of construction in graphical and textual form</td>
</tr>
<tr>
<td>Exit Condition:</td>
<td>The space-detailed design requires inspection and approval from the main designer and client. The space-detailed design requires external enclosing structures</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
</tr>
<tr>
<td>Description:</td>
<td>Items and structures on spaces are the items and structures raised for the need of spaces and used in the determination of the space requirements and dimensional requirements. Internal partition structures are spaces internal separating structures and the internal openings on them etc</td>
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### Context Setting

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<td>ANALYST</td>
<td>Genet Tesfagaber</td>
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<tr>
<td>Notes</td>
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<td>Façade detail design</td>
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</table>

Object State Name: Façade detail design

Label:

Transition From Object State:

Transition To Object State(s):

Facts: Façade detail design includes elaboration of the external enclosing structures and design of adornments

Constraints:

State Condition: The façade detail design must detail information on the locations, dimensional information, and material and method of construction of the external structures including adornments, the openings and their complimentary structures

Exit Condition: The façade detail design requires inspection and approval from the main designer and client. The façade detail design requires enclosing structure

Other:

Description: The façade, external-enclosing structures is the external shell of the building including other structural item associated with the external shell of the wall. The complimentary structure is the external openings complimenting structure this includes including external doors, windows

CONTEXT SETTING:  
REFERENCE:  
Scenario 1891

ITEM DESCRIBED: Façade detail design

FORM TYPE:  
Object State  
Elaboration
Object State Name: Roof detail design  
Label: Roof detail design

Transition From Object State: Façade detail design
Transition To Object State(s): Surface structure detail design

Facts: The roof detail design includes elaborated design of roof structures, roof openings and their complimentary structures and drainage.

Constraints:  
State Condition: The roof detail design must include detailed information on the roof layout openings and drainage including the dimensional information and material and method of construction of the roof and roof elements.

Exit Condition: The roof detail design requires inspection and approval from the main designer and client. The roof detail design requires surface structure elaboration and detailing.

Other: Method of construction includes detailed design of the connection and intersection between the elements of the roof and between the roof and mass and roof and complimentary structures.

<table>
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<th>CONTEXT SETTING REFERENCE</th>
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<th>FORM TYPE</th>
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<td>Roof detail design</td>
<td>Object State Elaboration</td>
</tr>
<tr>
<td>Object State No.</td>
<td>Object State Name:</td>
<td>Surface structure and finishes</td>
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<tr>
<td></td>
<td>Label:</td>
<td>Surface structure and finishes</td>
</tr>
<tr>
<td>OS 5</td>
<td>Transition From Object State</td>
<td>Roof detail design</td>
</tr>
<tr>
<td></td>
<td>Transition To Object State(s):</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td>Facts:</td>
<td>The surface structure and finishes detail design includes internal and external surface of a building, every elements and structures designed</td>
</tr>
<tr>
<td></td>
<td>Constraints:</td>
<td>The surface structure and finishes detail design must detail the quantitative and material and method of construction of the structure</td>
</tr>
<tr>
<td></td>
<td>Exit Condition:</td>
<td>The surface structure and finishes detail design requires inspection and approval from the main designer and client</td>
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<td></td>
<td>Other:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description:</td>
<td>The material and method of construction details the construction detail including connection and intersections. Surface structures include surface decorations and finishes of the</td>
</tr>
</tbody>
</table>

CONTEXT SETTING: FORM TYPE: REFERENCE: ITEM DESCRIBED: OBJECT STATE | SCENARIO 1891 | Surface structure | Object State | Elaboration |
### Pretender Procedure Process View

**UoB Name:** Pretender Procedure  
**UoB label:** Pretender Procedure

#### Objects:

#### Facts:

Pretender procedure involves all activities associated with tendering. This includes method statements that describe how a contractor intends to carry out a specific project work, and both strategy, operational methods, resources needed and identify key milestones. Planning and estimating, obtaining all prices for materials, plant, components, subcontract work and preliminaries. It is a process of estimating of the likely cost of all proposed work of a project and planning ways in which a project might be built indulging key milestones and likely rates of construction necessary to meet any imposed completion dates based on the contract document.

#### Constraint:

Pretender procedure is constrained by the terms and conditions of client's form of contract.

#### Description:

White space

---

**UoB Name:** Review tender invitation  
**UoB label:** Review tender invitation

#### Objects:

#### Facts:

Review of tender invitation involves the director and chief estimator task. Upon receipt of tender invitation, the director and chief estimator review the tender document prior to decision to generally examine the type, size and location of the proposed project.

#### Constraint:

White space

#### Description:

White space

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<tr>
<th>CONTEXT SETTING</th>
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<tr>
<td>REFERENCE:</td>
<td>Pretender Procedure and Review tender invitation</td>
<td>UoB elaboration</td>
</tr>
</tbody>
</table>

393
### UoB NO

**UoB Name:** Make Decision to Tender  
**UoB label:** Make Decision to Tender

**Objects:**

**Facts:** The decision to tender invitation involves the director and chief estimator task. Upon receipt of an invitation to tender a decision is taken by the director and chief estimator based on the review result of the tender document, the type of work, the location of the proposed contract, and the current work load and expected competitors. The production of letter of acceptance or decline is part of this task.

**Constraint:** White space

**Description:** White space

---

### UoB 5

**UoB Name:** Estimate Tender  
**UoB label:** Estimate Tender

**Objects:**

**Facts:** Estimating tender involves the tender estimator’s task. The estimator examines the tender document and collects all relevant and necessary information and collates them in a file to establish all-in rates and build unit rates in order to estimate the likely cost of all proposed project work.

**Constraint:** The estimating process is constrained by the terms and condition of the client’s form of contract

**Description:** White space

---

### Context Setting Reference

**ITEM DESCRIBED:** Make Decision to Tender and Estimate Tender

**FORM TYPE:** UoB elaboration

---
**Pre-tender Procedure Process View**

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<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Plan Tender</th>
<th>UoB label: Plan Tender</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objects:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Facts:</strong> Planning tender involves the planner's task. The tender planner extracts and collects all necessary and relevant information, identifies requirements, resources, the items of work and principal activities, and examines alternative methods in order to produce a programme in which the project might be built and determine the likely rates of construction necessary to meet any imposed completion dates.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Constraint:</strong> The tender planning process is constrained by terms and condition of the client's form of contract</td>
<td></td>
<td></td>
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<td><strong>Description:</strong> White space</td>
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<table>
<thead>
<tr>
<th>UoB 10</th>
<th>UoB Name: Build up complete estimate</th>
<th>UoB label: Build up complete Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objects:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Facts:</strong> Building up of complete estimate involves the tender estimators and planner task. This includes tender co-ordination meeting between the estimator and planner, pricing of bill of quantities and preliminaries following by arithmetical check of all works and review of later quotations in order to prepare complete estimate that report the total cost of all works including preliminaries outlined in the tender documentation.</td>
<td></td>
<td></td>
</tr>
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<td><strong>Constraint:</strong> White space</td>
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<td></td>
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<tr>
<td><strong>Description:</strong> White space</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Finalise and Submit Tender

**Objects:** Finalisation and submission of tender involves finalisation meeting followed by submission based on the tender estimator’s work, tender planner’s work, and buyer’s information and construction management’s knowledge. When a need for alternative contract duration and price arise, the issue is considered and discussed. On the basis of the agreed construction method, programme, selection of subcontractors and adjustments established, finalisation of the markups for overheads, profit and insurance and agreement on the fixed price allowance is sought when applicable.

**Constraint:** White space

**Description:** White space

### Examine Document

**Objects:** The estimation of tender starts with examination of the tender document. The estimator conducts detailed examination of the tender document to reveal the items in the bill of quantities in connection with their tender drawings and specifications for which quotation is required.

**Constraint:** White space

**Description:** White space

---

**CONTEXT SETTING:**

**REFERENCE:**

**ITEM DESCRIBED:** Finalise and Submit Tender and Examine Document

**FORM TYPE:** UoB elaboration

---

396
<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Collect Relevant Information</th>
<th>UoB label: Collect Relevant Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objects:</td>
<td>Insurance manager, estimator, enquiry clerk, tender invitations, subcontractors, suppliers, prices or quotation, chief estimator, insurance, contract, estimator, planner, site information, detailed and working drawings</td>
<td></td>
</tr>
<tr>
<td>Facts:</td>
<td>Collection of relevant information involves the following activities, The enquiry clerk's despatches invitations to tender to subcontractors and suppliers for submission of prices and cash settlement terms The chief estimator prepares an insurance enquiry sheet and seeks information on insurance on the contract. The estimator and planner collects site information form site visit and examine and collect detailed and working drawings not included in the tender documents from the (architects or engineers) consultant’s office visit</td>
<td></td>
</tr>
<tr>
<td>Constraint:</td>
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<tr>
<td>Description:</td>
<td></td>
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<table>
<thead>
<tr>
<th>UoB Name: Collate Quotations</th>
<th>UoB label: Collate Quotations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objects:</td>
<td>Tender enquiry abstract, lists pages numbers in the BoQs together with appropriate drawings that sent with a particular group of enquiry, estimator, quotations, subcontractors, suppliers, trades, analysis sheet, work items, drawings, bill extracts, tender invitations, analysis sheet</td>
</tr>
<tr>
<td>Facts:</td>
<td>Collation of quotations involves the estimator’s task. The estimator edits the quotations received back from subcontractors and suppliers into trades as appropriate. The quotation are then (filed) entered in to an analysis sheet for comparison to be made. The analysis sheet contains detail of work items in each trade. A file for every trade comprises the relevant tender enquiry abstract, the drawings and bill extracts despatched with the invitations to tender, the quotations received back and analysis sheet.</td>
</tr>
<tr>
<td>Constraint:</td>
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</tr>
<tr>
<td>Description:</td>
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</tr>
</tbody>
</table>

CONTEXT SETTING
REFERENCE: Collect Relevant Information and Collate Quotations
FORM TYPE: UoB elaboration
### Establish All-In-Rates

**Objects:**

- **Facts:** The establishment of all-in-rate process involves the estimator’s task. The estimator prices little of the work or trade. To build up unit rates for these items, the estimator first establishes all-in-rates for labour, plant and materials. For labour, an all-in-hourly rate is calculated. Major items of plant are charged under the project overhead (preliminaries), and for small plants all-in-rates which include all services (basic hire charges, running costs, erection and transport costs) are calculated. Material all-in-rates are based on the quotations received back from suppliers. Before meaningful comparisons are made, the quotations are transferred into all-in-rates by making allowance for other associated service’s cost. Having calculated all-in-rates, the estimator selects the keenest reliable supply quote for inclusion in the tender. For meaningful comparison, the tenders are adjusted by means of allowance for risk, attendance and price fluctuations. This is done in liaison with the buyer.

**Constraint:**

**Description:**

### Build up Unit Rates

**Objects:**

- **Facts:** Building up of unit rates involves the estimator’s task. For the trades that are priced in the building up of all-in-rates process, unit rates are built up for each measured item in the bill of quantities. Unit rates usually consist of elements for labour, plant and materials. The subcontract tenders selected are examined and checked to ensure allowance has been included for other services such as stores, protection etc.

**Constraint:**

**Description:**
**Appendix C**

**Pre-tender Procedure Process View**

<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Extract Information</th>
<th>UoB label: Extract Information</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Objects:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facts:</td>
<td>The process involves the tender planner’s task. The tender planning process starts with extraction of relevant information. Upon receipt of the completed tender summary sheet and a set of tender document, the tender planner extracts all the bulk quantities from the bill of quantities and identifies the plant and scaffold requirements. The abstraction of scaffold requirements onto scaffold schedule and the list of major plant requirements enable for enquiry to be dispatched. Any temporary work requirements may be referred to the engineering department for the design for difficult propping and support systems.</td>
</tr>
<tr>
<td></td>
<td>Constraint:</td>
<td>The extraction of relevant information requires the preamble and specifications for example, for restrictions in countering bay sizes, the type of concrete mixes to be used and any other production related constraints.</td>
</tr>
<tr>
<td></td>
<td>Description:</td>
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<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Collect Necessary Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects:</td>
</tr>
<tr>
<td></td>
<td>Facts: The collection of necessary and relevant information involves the planner’s responsibility in acquiring quotations for scaffold, plant, and temporary work that may be required. The scaffold schedule with enquiry letter is dispatched as soon as the scaffold requirements have been defined. The major plant requirements are highlighted as the method of construction is decided and the programmed activity duration calculated. The planner in conjunction with the estimator makes visit to the site as well as the consultant’s office to collect more information, which is not included in the tender document.</td>
</tr>
<tr>
<td></td>
<td>Constraint: White space</td>
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<td>Description: White space</td>
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</tbody>
</table>

**Context Setting Reference:**

| ITEM DESCRIBED: Extract Information and Collect Necessary Information | FORM TYPE: UoB elaboration |
### Resource Bill of Quantities & Activities

**UoB Name:** Resource bill of quantities & activities  
**UoB label:** Resource BoQs & Principal Activities

**Objects:**
- The resource of bill of quantities and principal activities involves the planner's task. The planner proceeds to resource the bulk quantities abstracted for each principal activity in terms of their labour and plant content. Using own output the constants for labour and plant, activity duration are calculated initially on the basis of the most sensible and obvious resource strength. All possible method of construction are analysed and resourced and alternative solutions are appraised and the optimum solutions are sought for each activity.

**Constraint:** White space  
**Description:** White space

### Produce Method Statement

**UoB Name:** Produce Method Statement  
**UoB label:** Produce Method Statement

**Objects:**
- The production of method statement involves the tender planner's task. As the activities are resourced and optimum solutions are calculated, they are entered onto a method statement sheet. Each activity is numbered and given a brief description (in an operational logic). Plant requirements for each activity are also listed. The average output and quantities of work in each activity together with resulting duration are listed under the appropriate heading. A note is made of the method sequence (dependent and related activities) together with any remarks; such as assumptions made.

**Constraint:** White space  
**Description:** White space

---

**CONTEXT SETTING REFERENCE**  
**ITEM DESCRIBED:** Resource bill of quantities & activities and produce method statement  
**FORM TYPE:** UoB elaboration

---

400
The draft pre-tender process involves the production of pre-tender construction programme, which is a graphical representation of the proposed construction process. The programme is produced based on the activities, duration and calendar dates, which are entered on the method statement sheet. In addition to showing the activities, the planner marks up the dates by which design information is required for each activity. The level of detail given at the pre-tender stage depends largely upon the nature of the work.

**Constraint:** White space

**Description:** White space

The production of preliminary schedule involves the tender planner's work. The planner upon completion of the pre-tender programme fills a standard company's preliminaries schedule. This comprehensive list prompts consideration of all the possible project overheads not attributable to measured items.

**Constraint:** White space

**Description:** White space
# Pre-tender Procedure Process View

## Appendix C

<table>
<thead>
<tr>
<th>USE AT</th>
<th>ANALYST: Genet Tesfagaber.</th>
<th>X</th>
<th>WORKING:</th>
<th>REVIEWED</th>
<th>DATE:</th>
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<tr>
<th>UoB NO</th>
<th>UoB Name: Co-ordinate Tender</th>
<th>UoB label: Co-ordinate Tender</th>
</tr>
</thead>
</table>

### Objects: Co-ordinate Tender

### Facts:
The building up of complete estimate start with, co-ordination meeting between the tender estimator and planner, to discuss the tender and bring the two sections of estimate together prior to the final stage. This is for the purpose of consistency to the tender preparation and to give both parties a fuller appreciation of the estimate. The meeting focuses on the preliminaries schedule, exchange of tender information, pre-tender programme and associated method statements and discuss on alternatives to client’s completion date.

### Constraint:
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### Description:
White space

<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Price Bill of Quantities</th>
<th>UoB label: Price Bill of Quantities</th>
</tr>
</thead>
</table>

### Objects: Price Bill of Quantities

### Facts:
Pricing the bill of quantities involves the estimator’s task. The estimator builds up measured rates against the bill of quantity items based on the unit rates for labour, plant and materials. An analytical bill showing labour, plant and materials subtotals are completed and all workings, build-ups and extensions are passed for arithmetical checking.

### Constraint:
White space

### Description:
White space

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**CONTEXT SETTING REFERENCE:** Co-ordinate Tender and Price Bill of Quantities

**FORM TYPE:** UoB elaboration
UoB Name: Price Preliminaries Schedule
UoB label: Price Preliminaries Schedule

Objects:

Facts: Pricing the preliminary schedule involves estimator’s task the estimator prices the resourced preliminaries schedule based on the quotations obtained by the planner and passed to the estimator, that forms the basis for the rates used for scaffold, major plants and tower-crane requirements. Each resourced item is priced The value of the preliminaries is summarises and priced at cost The priced schedule together with any working etc are passed for checking.

Constraint: White space

Description: White space

UoB Name: Make Arithmetical Check
UoB label: Make Arithmetical Check

Objects:

Facts: Arithmetical check process follows the pricing of the bill of quantities and preliminaries schedule. All the work sheets, extensions, measured rates, trades/section totals are checked and mistakes are corrected.

Constraint: White space

Description: White space
### Pre-tender Procedure: Process View

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<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Review Quotations</th>
<th>UoB label: Review Quotations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects:</td>
<td></td>
</tr>
<tr>
<td>UoB27</td>
<td>Facts: Review of the late quotations can be carried out after the closing date as further subcontractors and suppliers quotations arrived after closing date may be analysed and compared against those already selected for inclusion in the estimate before the finalisation of meeting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constraint: This process may be constrained by the condition and agreement of the contract</td>
<td></td>
</tr>
<tr>
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</tr>
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<table>
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<tr>
<th>UoB NO</th>
<th>UoB Name: Summarise Estimate</th>
<th>UoB label: Summarise Estimate</th>
</tr>
</thead>
<tbody>
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<td>Objects: White space</td>
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<td></td>
<td>Facts: White space</td>
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**Context Setting Reference**: Review Quotations and Summarise Estimate

**Form Type**: UoB elaboration

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404
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<th>Date</th>
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<th>REVIEWER</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Genet Tesfaga</td>
<td>date'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROJET</td>
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<td>REV.</td>
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<th>Object State No.</th>
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<th>Label:</th>
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<tbody>
<tr>
<td>OS 1</td>
<td>Tender invitation</td>
<td>Tender invitation</td>
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</table>

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<th>Transition From Object State</th>
<th>Transition To Object State(s):</th>
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<tbody>
<tr>
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<td>Design document</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Facts:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tender invitation includes tender document, tender drawings, specifications, bill of quantities, conditions of tender and proposed form of contract and any other relevant or unusual conditions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Constraints:</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Condition:</td>
</tr>
<tr>
<td>The tender invitation must include all the necessary information at the required level for estimating these include; the bill of quantities, drawings, and specifications</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exit Condition:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tender invitation requires review and analysis by the chief estimator before decision can be made</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
</tr>
<tr>
<td>The bill of quantities represent gives a brief description and the quantities of all the items of work involved in a proposed project. Tender drawings are represent the detailed drawing produced during the design stage of a project. The specifications specify the</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTEXT SETTING</th>
<th>ITEM DESCRIBED</th>
<th>FORM TYPE</th>
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<tbody>
<tr>
<td>REFERENCE</td>
<td>Tender invitation</td>
<td>Object State</td>
</tr>
<tr>
<td>Scenario 1 0</td>
<td>Tender invitation</td>
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<tr>
<td>DATE AT</td>
<td>PROJECT</td>
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<tr>
<th>Object State No.</th>
<th>Object State Name: Tender declined</th>
<th>Label: Tender declined</th>
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<tbody>
<tr>
<td>Transition From</td>
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<td>Object State</td>
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<td>Transition To Object</td>
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</tr>
<tr>
<td>State(s):</td>
<td>________</td>
<td></td>
</tr>
</tbody>
</table>

**Facts:** Tender declined includes letter of decline. Upon receipt of the tender invitation, the chief estimator reviews the tender document before a decision can be made. A letter of decline is prepared and sent to the client.

**Constraints:**
- **State Condition:** A letter of decline must be prepared
- **Exit Condition:** A letter of decline must be sent to the client

**Description:**

<table>
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<tr>
<th>CONTEXT SETTING</th>
<th>ITEM DESCRIBED</th>
<th>FORM TYPE</th>
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<td>Object State Elaboration</td>
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<tr>
<td>Scenario 10</td>
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Appendix C

Pre-tender Procedure Object View

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<tr>
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<th>WORKING</th>
<th>REVIEWER</th>
<th>DATE</th>
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<tbody>
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<tr>
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<tbody>
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</table>

<table>
<thead>
<tr>
<th>NOTES:</th>
<th>REV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Object State No.</th>
<th>Object State Name: Tender accepted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Label: Tender accepted</td>
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</table>

<table>
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<tr>
<th>Transition From Object State</th>
<th>Tender received</th>
</tr>
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<tbody>
<tr>
<td>Transition To Object State(s):</td>
<td>Tender document</td>
</tr>
<tr>
<td>State(s):</td>
<td>Tender summary sheet</td>
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</table>

<table>
<thead>
<tr>
<th>Facts:</th>
<th>Tender accepted lead to tender estimating and planning. It includes tender acceptance letter</th>
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</table>

<table>
<thead>
<tr>
<th>Constraints:</th>
<th>State Condition: There must be a decision made to accept tender invitation and letter of acceptance prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exit Condition:</td>
<td>A letter of acceptance must be sent to client.</td>
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<tr>
<td>Other:</td>
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</table>

<table>
<thead>
<tr>
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<th>CONTEXT SETTING</th>
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<th>FORM TYPE</th>
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<td>Object State Elaboration</td>
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<td>Scenario 10</td>
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<td></td>
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<tr>
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<tr>
<td>PROJECT</td>
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### Object State No. OS 5

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<td>Label:</td>
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<td>Transition To Object State(s):</td>
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<td>Facts:</td>
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<td>Constraints:</td>
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</tr>
<tr>
<td>State Condition:</td>
<td>The tender document must contain the drawings, specifications of the project and the items of work and quantities of the work items</td>
</tr>
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<td>Exit Condition:</td>
<td>The tender document requires examination and check by the chief estimator and director before estimating and planning stages</td>
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408
## Object State Name
Tender summary sheet

### Label
Tender summary sheet

### Transition From
Tender accepted

### Transition To Object State(s):
- Tender estimated
- Tender planned

### Facts:
Tender summary sheet must summarize all the details in the tender document.

### Constraints:
- Tender summary sheet is a summary of the tender details and including observations or unusual features noted by the director and chief estimator

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<tbody>
<tr>
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<td>Tender summary sheet</td>
</tr>
<tr>
<td>Complete estimate</td>
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</table>

| Facts: | Estimated tender includes the likely cost of all proposed work, including all-in-rates and unit rates and measured rates |

<table>
<thead>
<tr>
<th>Constraints:</th>
<th>State Condition:</th>
<th>The estimated tender must include all the likely cost of each work item in the BoQs, measured rates and unit rates prior to the completion and finalisation of the estimate process</th>
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<th>Exit Condition:</th>
<th>The estimated tender requires tender coordination meeting between the estimator and planner</th>
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Scenario 10
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<td>Facts:</td>
<td>Complete estimate</td>
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<td>Constraints:</td>
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<tr>
<td>State Condition:</td>
<td>The planned tender must include the preliminary schedule completed and quotations.</td>
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<td>Exit Condition:</td>
<td>The planned tender requires check and estimating and tender coordination meeting between the estimator and the planner prior to completion of the estimate</td>
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<td>Other:</td>
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**CONTEXT SETTING**
- ITEM DESCRIBED: Tender planned
- FORM TYPE: Object State
- Elaboration

**REFERENCE:**
- Scenario 10
### Pre-tender Procedure Object View

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<table>
<thead>
<tr>
<th>Transition To Object State(s):</th>
<th>Tender planned</th>
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</table>

| Facts: The completed estimate includes the total cost of all proposed works, including preliminaries in tender documentation |
| Constraints: The complete estimate must include all the costs of the proposed project in detail |
| Exit Condition: The completed estimate requires tender finalisation |

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123
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<td>Tender file requires check and analysis for completeness</td>
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413
Object State No. | Object State Name: Tender enquiry abstract  
| Label: Tender enquiry abstract  
| Transition From Object State | Tender document  
| Transition To Object State(s): | Tender summary sheet, Quotations  
| Facts: | Tender enquiry abstract contains list of page numbers in the BoQs together with appropriate drawings that's sent with particular group of enquiries. It is a data that is sent with a letter of invitation for enquiries to material suppliers.  
| Constraints: State Condition: | The tender enquiry abstract must contain bill extracts from the BoQs and appropriate drawings and for enquiry for supply of material or/and equipment.  
| Exit Condition: | The tender enquiry abstract requires check and examination by the enquiry clerk before despatch to suppliers.  
| Other: |  
| Description: |  

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### Direct Work Abstract

**Object State Name:** Direct work abstract  
**Label:** Direct work abstract  
**Transition From Object State:** Tender enquiry abstract  
**Transition To Object State(s):** All-in-rates  
**Facts:** Direct work abstract is an item of work, which is priced as a whole work package.  
**Constraints:**  
- **State Condition:** The direct work abstract must state the work as a whole task or work.  
- **Exit Condition:** For direct work abstract requires unit rates so all in rates must be developed.  
**Other:**  
**Description:** Direct work abstract does not need quotations for separate resources. Such as labour, material, plant or equipment. Direct work abstract is a package of work contracted or supplied as a package for certain amount of money.  

**CONTEXT SETTING ITEM DESCRIBED**  
**REFERENCE:** Scenario 8.1  
**ITEM DESCRIBED:** Direct work abstract  
**FORM TYPE:** Object State Elaboration
### Object State View

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<td>Tender enquiry abstract</td>
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<tr>
<td>Transition To Object State(s):</td>
<td>Comparison sheet</td>
</tr>
<tr>
<td>Facts:</td>
<td>Quotations are quoted prices or cost for supply of material or for subcontract of work that are received from suppliers and subcontractors upon invitation to tender for particular work or enquiry for material supply</td>
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<tr>
<td>Constraints:</td>
<td></td>
</tr>
<tr>
<td>State Condition:</td>
<td>The quotations must state the prices or costs and cash settlement terms and other relevant information</td>
</tr>
<tr>
<td>Exit Condition:</td>
<td>Quotations require comparison so they need to be edited in to file for a comparison to be made</td>
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<td>Other:</td>
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</tr>
<tr>
<td>Description:</td>
<td>Quotations are quoted prices for separate material, labour or equipment</td>
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### CONTEXT SETTING

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416
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Object State No. OS 6

Object State Name: Comparison sheet
Label:

Transition From Quotations
Object State
Transition To Object State(s): All-in-rates

Facts: Comparison sheet comprises a relevant tender enquiry abstract, quotations and analysis sheet for each trade.

Constraints:
State Condition: Comparison sheet must contain the quotations received with appropriate enquiry abstracts entered into analysis sheet for comparison to be made

Exit Condition:
Other:

Description: Analysis sheet is a file containing the quotations received with appropriated tender enquiry abstracts for comparison purpose

CONTEXT SETTING
REFERENCE:
Scenario 81

ITEM DESCRIBED
FORM TYPE:
Object State Elaboration
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### Object State No. 7 (OS 7)

**Object State Name:** All-in-rates  
**Label:** All-in-rates  
**Transition From Object State:** Comparison sheet  
**Transition To Object State(s):** Direct work abstract

**Facts:** All-in-rates are established price rates made of all-in-hourly rates for labour and plant, and all-in-rates for material, for a trade or section of work.

**Constraints:**
- **State Condition:** All-in rates must comprise all-in-hourly rates for labour and plant and all-in rates for materials. This does not comprise rates for major items of plant.
- **Exit Condition:** For trades or work section that are priced, or for which All-in-rates is established require unite rates built up for each measured items in the BoQ.

**Other:**

**Description:** All-in rates are made up of all-in rates for the resources, labour, material, and plants or equipment. Major items of plant are charged under project overhead.

### Context Setting

**REFERENCE:** All-IN-rates Object State Elaboration  
**Scenario 8.1**

### Item Described

**Item Described:** All-in-rates  
**Form Type:** Object State Elaboration
## Appendix C

**Pre-tender Procedure Object View**

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<td>Transition From Object State</td>
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<td>Transition To Object State(s)</td>
<td>Measured rates</td>
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<td>Preliminaries priced</td>
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**Facts:**
Unit rates are price rates per measure unit for each measured item in the BoQ

**Constraints:**
- **State Condition:** Unit rates must consists of elements for labour plant and materials
- **Exit Condition:** Unit rates are built up for pricing the measured items in the BoQs. Unit rates built up for each measured work items in the BoQ requires tender co-ordination meeting to prior to completion of the estimate
- **Other:**

**Description:**
Unit rates are built up based on the all-in-rates established for a trade or section of work. So it consist elements for labour, plant and materials.

### CONTEXT SETTING

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**Pre-tender Procedure  Object View**

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### Object State

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### Transition From

- **Object State**: Unit rates and quotations
- **Transition To Object State(s)**: Preliminary schedule and supporting quotations

### Facts:

Measured rates are rates that are built up from the basis of the unit rates against the measured items in the BoQs

### Constraints:

- **State Condition**: Measured rates must consist of elements for labour, plant, material and direct work. Quited and direct work items must have measured rates
- **Exit Condition**: All the workings, build-ups and extensions require arithmetical check before completions of the estimate.

### Other:

**Description:**

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### Object State Name

| OS 10          | Preliminary schedule and supporting quotations |

### Transition From

| Object State | Preliminaries priced |

### Transition To Object

| State(s):      | Completed estimate |

### Facts:

Priced preliminaries are a company’s standard preliminaries schedule with comprehensive list, which is filled and resourced by the planner and priced by the estimator.

### Constraints:

**State Condition:** The priced preliminaries must have all the possible project overheads not attributable to measured items, priced on the basis of the quotations obtained by the planner.

**Exit Condition:** The priced preliminaries require arithmetical check prior to completion and summary of the estimate.

### Description:

Priced preliminaries or company’s standard preliminaries schedule includes components summary sheet, accommodation, supervisions, site set up, temporary services, temporary site electric, mechanical plant, craneage, scaffolding, protections and sundries, maintain and tidy, transport, special conditions.

### CONTEXT SETTING

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### Object State No. OS 11

#### Object State Name: Completed estimate
- Label: Completed estimate

#### Transition From Object State
- Measured rates
- Preliminaries priced

#### Transition To Object State(s):
- Tender file

**Facts:**
A complete estimate represents the total cost of all construction work including preliminaries outlined in tender documentation.

**Constraints:**

#### State Condition:
The completed estimate must consist of elements of cost for every item of work in the BoQs and preliminaries outlined in tender documentation.

#### Exit Condition:
The completed estimate requires tender finalisation meeting for consideration and discussion on alterations in contract duration, price mark-ups for overheads, profit and insurance; price allowances or other relevant issues.

**Other:**

**Description:**

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<td>Facts:</td>
<td>Tender file includes a completed estimate that represents the total cost of all work times and preliminaries, contract duration, total cost, etc</td>
</tr>
<tr>
<td>Constraints:</td>
<td>Tender file must include cost of all work items and preliminaries</td>
</tr>
<tr>
<td>State Condition:</td>
<td>Tender file requires check and analysis by the client</td>
</tr>
<tr>
<td>Exit Condition:</td>
<td>Tender file requires check and analysis by the client</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>

**Description:**

- **CONTEXT SETTING**
  - Reference: Scenario 11
  - Item Described: Tender file
  - Form Type: Object State Elaboration
## APPENDIX C

### Pre-tender Procedure Object View

<table>
<thead>
<tr>
<th>Date At</th>
<th>Analyst</th>
<th>Date</th>
<th>Working Review</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Genet Tesfagaber</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Project:** Draft

**Notes:**

<table>
<thead>
<tr>
<th>Object State No.</th>
<th>Object State Name: Bulk quantities of principal activities</th>
<th>Label: Bulk quantities of principal activities</th>
</tr>
</thead>
</table>

**Transition From Object State:** Tender document

**Transition To Object State(s):** Tender summary sheet

**Bulk quantities of principal activities resourced**

**Method logic**

**Facts:** The bulk quantities are the major work items in the bill of quantity

**Constraints:**

**State Condition:** The bulk quantity must contain brief description and quantities of all the major work items based on the method of construction used

**Exit Condition:** The bulk quantities require resources for the principal activities

**Other:**

**Description:**

<table>
<thead>
<tr>
<th>Context Setting</th>
<th>Item Described: Bulk quantities of principal activities</th>
<th>Form Type: Object State Elaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference:</td>
<td>Scenario 91</td>
<td></td>
</tr>
</tbody>
</table>

---

424
### Object View

**Object State Name**: Temporary resource required  
**Label**: Temporary resource required

**Transition From Object State**: Tender document  
**Transition To Object State(s)**: Temporary work details and quotations

**Facts**: Temporary resources are the major resources such as scaffolds, major plants, and temporary work that may be required to perform the bulk quantities of the bill of quantities.

**Constraints**:  
**State Condition**: The temporary resources required must be abstracted into schedules and lists as appropriate to be despatched for enquiry and invitation to tender.

**Exit Condition**: The schedule and list of the temporary resources required require check for completeness and letter of enquiry that despatched along with the schedule and list of the major resources for quotations enquiry from suppliers.

**Other**:  

**Description**:

<table>
<thead>
<tr>
<th>CONTEXT SETTING</th>
<th>ITEM DESCRIBED</th>
<th>FORM TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Temporary resource required</td>
<td>Elaboration</td>
</tr>
</tbody>
</table>

Scenario 11
### Pre-tender Procedure Object View

<table>
<thead>
<tr>
<th>DATE AT:</th>
<th>ANALYST: Genet Tesfagaber</th>
<th>DATE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT</td>
<td>WORKING REVIEWER:</td>
<td></td>
</tr>
<tr>
<td>NOTES REV:</td>
<td>RECOMMEND</td>
<td>RELEASED</td>
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</table>

### Object State Number: OS 5

<table>
<thead>
<tr>
<th>Object State Name:</th>
<th>Quotations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label:</td>
<td>Quotations</td>
</tr>
</tbody>
</table>

**Transition From Object State:** Temporary resource required

**Transition To Object State(s):** Bulk quantities of principal activities resourced

**Method logic:**

**Facts:** Possible suppliers and subcontractors quote quotations for the resources required

**Constraints:**

- **State Condition:** The quotations must contain detail of the prices and any other relevant conditions necessary
- **Exit Condition:** The quotations are required for pricing the preliminaries schedule the quotations requires estimator’s work for pricing the preliminaries schedule

**Other:**

**Description:**

| CONTEXT SETTING REFERENCE: Scenario 11 | ITEM DESCRIBED: Temporary work detail and quotations | FORM TYPE: Object State Elaboration |

---

426
## AppendiX C  
Pre-tender Procedure Object View

| DATE  | ANALYST: Genet Tesfagaber date: WORKING REVIEW: DATE |
|-------|------------------------------------------------------|--------------------------------------------------|
| AT    |                                                      |                                                  |
| PROJECT: |                                                   |                                                  |
| NOTES | REV:                                                  |                                                  |

### Object State No.

<table>
<thead>
<tr>
<th>Object State Name:</th>
<th>Label:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method/logic</td>
<td>Method/logic</td>
</tr>
</tbody>
</table>

#### Transition From

**Object State:**
Temporary work details and quotations

#### Transition To Object State(s): Programmed duration

#### Facts:
Method/logic is the operational method or method of construction considered in the resource exercise

#### Constraints:
- **State Condition:** The method/logic must state the methods of construction considered or chosen
- **Exit Condition:** The method/logic are required in the resource exercise of the principal activities

#### Description:

<table>
<thead>
<tr>
<th>CONTEXT SETTING NETWORK ITEM DESCRIBED</th>
<th>FORM TYPE.</th>
</tr>
</thead>
<tbody>
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<td>Scenare 11</td>
<td>Elaboration</td>
</tr>
</tbody>
</table>

**Table:**
- **Method/logic State Reference**
- **Object State Elaboration**

---

427
### Object State No.

**OS 7**

<table>
<thead>
<tr>
<th>Object State Name:</th>
<th>Bulk quantities of principal activities resourced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label:</td>
<td>Bulk quantities of principal activities resourced</td>
</tr>
</tbody>
</table>

**Transition From Object State:**

- Bulk quantities of principal activities

**Transition To Object State(s):**

- Programmed duration

**Facts:**

The principal activities resourced are list of principal activities resourced in terms of their labour and plant contents based on the method of construction considered in the resource exercise.

**Constraints:**

- **State Condition:**
  - The principal activities must be principal activities resourced with optimum solution

- **Exit Condition:**
  - The resourced principal activities require time duration for the resource to perform the activities

**Other:**

**Description:**

**CONTEXT SETTING**

**REFERENCE:**

Scenario 11

**ITEM DESCRIBED:**

Bulk quantities of principal activities resourced

**FORM TYPE:**

Object State Elaboration
<table>
<thead>
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<th>WORKING</th>
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<th>DATE:</th>
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<tbody>
<tr>
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<th>REV</th>
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<tr>
<td>Object State No.</td>
<td></td>
</tr>
<tr>
<td>OS 8</td>
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</tbody>
</table>

| Object State Name: | Programmed duration |
| Label: | Programmed duration |

<table>
<thead>
<tr>
<th>Transition From Object State</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Bulk quantities of principal activities resourced</td>
<td></td>
</tr>
<tr>
<td>Method logic</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transition To Object State(s):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary schedule</td>
<td></td>
</tr>
<tr>
<td>Supporting quotations</td>
<td></td>
</tr>
<tr>
<td>Resource data</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facts:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Programmed duration are construction programme i.e. a graphical representation of a proposed construction process</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Constraints:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>State Condition:</td>
<td>Programmed duration must have description of the work items programmed and placed calendar dates Activity duration must have start and completion times determined by the logic imposed by the construction method considered</td>
</tr>
<tr>
<td>Exit Condition:</td>
<td>Programmed duration requires check for completion and constructability</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Description:</th>
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<table>
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<th>ITEM DESCRIBED</th>
<th>FORM TYPE</th>
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</thead>
<tbody>
<tr>
<td>Reference:</td>
<td>Programmed duration</td>
<td>Object State Elaboration</td>
</tr>
</tbody>
</table>
### Object View

#### Preliminary Schedule

**Object State No.**

**Object State Name:** Preliminary schedule  
**Label:** Preliminary schedule

**Transition From**

**Object State:** Programmed duration

**Transition To Object**

**State(s):** Measured rates and preliminaries priced

**Facts:** Preliminary schedule is a standard company's preliminaries schedule, which is filled by the planner upon completion of the pre-tender programme

**Constraints:**

- **State Condition:** The preliminary schedule must consider all the possible project overheads not attributable to measured rates
- **Exit Condition:** The preliminary schedule requires check and approval by the director for completeness and need be priced by the estimator

**Other:**

**Description:**

<table>
<thead>
<tr>
<th>CONTEXT SETTING</th>
<th>ITEM DESCRIBED</th>
<th>FORM TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCE:</td>
<td>Preliminary schedule</td>
<td>Object State</td>
</tr>
<tr>
<td>Scenario 1</td>
<td>Elaboration</td>
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</table>

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430
<table>
<thead>
<tr>
<th>DATE AT:</th>
<th>ANALYST: Genet Tesfagaber</th>
<th>PROJECT</th>
<th>WORKING</th>
<th>REVIEWER</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES**

<table>
<thead>
<tr>
<th>Object State No.</th>
<th>Object State Name: Supporting quotations</th>
<th>Label: Supporting quotations</th>
</tr>
</thead>
</table>

**Transition From Object State**

**Transition To Object State(s):** Measured rates and preliminaries priced

**Facts:** Supporting quotations are competitive quotations under consideration received from suppliers and subcontractors

**Constraints:**

**State Condition:** Supporting quotations must state the prices and other relevant condition

**Exit Condition:** Supporting quotations required for pricing the preliminaries schedule

**Other:**

**Description:**

<table>
<thead>
<tr>
<th>CONTEXT SETTING</th>
<th>ITEM DESCRIBED: Supporting quotations</th>
<th>FORM TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCE</td>
<td>Scenaro 11</td>
<td>Object State Elaboration</td>
</tr>
</tbody>
</table>
Object State Name: Resource data

Transition From Programmed duration

Facts: Resource data are data for project strategy includes resources data, site layout plan, method statement, pre-tender programme and programme alternatives

Constraints:
State Condition: White space
Exit Condition: White space

Other:
Description: White space
<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Plan &amp; Schedule Construction Operation</th>
<th>UoB label: Plan &amp; Schedule Construction Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objects:</td>
<td>Task (work items), resource, construction-task, time-duration, task-sequences, construction-schedule, planner, calendar date</td>
<td></td>
</tr>
<tr>
<td>Constraint:</td>
<td>Planning and scheduling involves analysing the work items and resource usage and aggregating them into construction tasks at the appropriate level for scheduling. The possible time duration of each task is estimated. A construction schedule is then created based on the tasks aggregated and time duration estimated and calendars dates.</td>
<td></td>
</tr>
<tr>
<td>Description:</td>
<td>Planning and scheduling process requires detailed information of the work items (tasks) and level of detail required for the schedule. It also requires analysis and check for completeness and contractibility of the schedule. The planners identify or collect work items or tasks information, estimate the how long (time duration) each task will take and identify sequences by investigating the relationships and dependencies between the tasks. Time duration is estimated based on the resource usage. Sequences of the tasks are identified based on the dependencies and relationship between tasks. Calendar dates are then placed and construction (production) schedule is created. The schedule is then analysed and checked for completeness and contractibility.</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

<table>
<thead>
<tr>
<th>Context Setting Reference. Scenario 5</th>
<th>Item Described</th>
<th>Form Type: UoB elaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan &amp; Schedule Construction Operation</td>
<td>Plan &amp; Schedule Construction Operation</td>
<td>Plan &amp; Schedule Construction Operation</td>
</tr>
</tbody>
</table>

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## Pre-construction Scheduling Process

### Process View

<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Carry out Scope Analysis</th>
<th>UoB label: Carry out Scope Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects:</td>
<td>Project, construction schedule, construction operation, project information, planner, project objectives, activity, task,</td>
</tr>
<tr>
<td></td>
<td>Facts:</td>
<td>Scope analysis involves identification of the objectives of the project and level of detail of the work items (tasks) required for the construction schedule based on the purpose of the schedule, (for construction or production or for tendering). Activity, tasks or work items level of detail required is determined at this stage of process</td>
</tr>
<tr>
<td></td>
<td>Constraint:</td>
<td>Scope analysis requires project objectives, project information and information about the purpose of the schedule itself</td>
</tr>
<tr>
<td></td>
<td>Description:</td>
<td>The planner collects project information and identifies the level of detail of the work items required in the schedule based on the project objectives and purpose of the schedule and the purpose of the schedule itself</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Identify Construction Task</th>
<th>UoB label: Identify Construction Task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects:</td>
<td>Identification of the work items or construction tasks is done based on available information Work items may be identified from an existing work items data such as estimating data or designed product items data. Where existing work items such as cost estimating work items (tasks) data is used, the tasks require aggregation into construction tasks at appropriate level for scheduling and resources are assigned. Where no existing work items or tasks data is available, designed product items and the resources that perform the tasks in realising the designed product item are used to derive the work items and tasks for the scheduling</td>
</tr>
<tr>
<td></td>
<td>Facts:</td>
<td>Identification of work items or tasks require product design data and/or existing work items or tasks such as cost estimating data in the case where project cost estimate is done</td>
</tr>
<tr>
<td></td>
<td>Constraint:</td>
<td>The planner can identify scheduling tasks based on available information. There are two possible information sources for identifying scheduling tasks, tasks can be obtained from cost estimating data or can be derived from design data</td>
</tr>
</tbody>
</table>

### Context Setting

<table>
<thead>
<tr>
<th>Reference:</th>
<th>ITEM Described: carry out scope analysis &amp; identify construction task</th>
<th>Form Type: UoB elaboration</th>
</tr>
</thead>
</table>

Scenario 2
Appendix C
Pre-construction Scheduling Process Process View

<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Estimate Duration</th>
<th>UoB label: Estimate Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects: Time duration, task, resource, resource usage, construction schedule, labour, major material, equipment, planner,</td>
<td>Facts: Estimating duration process involves determination of a possible time length that a task will take based on the resource usage. Resource usage in the construction schedule includes most of labour resources but only major materials and equipment resources. The time duration for each task is estimated based on the time length required by a resource to perform the task.</td>
</tr>
<tr>
<td></td>
<td>Constraint: Estimating time duration of each task requires resources and resource usage information</td>
<td>Description: After tasks are identified, the planner assigns resources and estimates the time duration for each task based on the resource usage information</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Define Relationship between Tasks</th>
<th>UoB label: Define Relationship between Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects: Construction task, tasks (construction) sequence, relationship, precedence logic, planner, predecessor/successor task,</td>
<td>Facts: Construction tasks usually happen in sequences. Defining relationship between tasks involves creating construction tasks sequences based on the dependency and relationship between tasks. The relationship between construction tasks is identified based on the task dependencies on one other</td>
</tr>
<tr>
<td></td>
<td>Constraint: Defining relationship between tasks requires precedence logic (the interactivity sequencing constraint)</td>
<td>Description: After identification of a task, a planner identifies a predecessor task and defines relationship between the predecessor and the successor tasks. The planner creates construction tasks sequences by linking dependant tasks and defines relationship between the tasks based on the precedence logic</td>
</tr>
</tbody>
</table>

CONTEXT SETTING REFERENCE
Scenario 2: Estimate time Duration and Define Relationship between Tasks

FORM TYPE: UoB elaboration

435
### UoB 8

**Name:** Complete Schedule  
**Label:** Complete Schedule  
**Objects:** Complete schedule, calendar dates, task, time duration, relationship, resource usage, planner.

**Facts:** The complete schedule activity involves placing calendar dates (assigning start and end times of the tasks) to tasks based on the estimated time duration for each task and the relationships between them.

**Constraint:** Completing schedule requires completeness and contractibility check and analysis.

**Description:** After tasks identified, time duration for each task is estimated based on the resource usage, relationships between tasks defined the planner places calendar dates and complete the schedule and analysis and check for completeness and contractibility is carried out.

### UoB 9

**Name:** Identify Tasks from Existing Data  
**Label:** Identify Tasks from Existing Data  
**Objects:** Cost estimating task, scheduling task, aggregated task.

**Facts:** Where available cost estimating tasks can be used for scheduling.

**Constraint:** Cost estimating work items or tasks require aggregation into tasks at the appropriate level for scheduling based on the purpose of the schedule.

**Description:** Where cost estimating tasks are used for scheduling the planner aggregates the estimating into appropriate level for scheduling.
<table>
<thead>
<tr>
<th>UoB No</th>
<th>UoB Name: Aggregate Tasks</th>
<th>UoB label: Aggregate Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects: Cost estimating data, Cost estimating task, scheduling tasks,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facts: Where cost estimating data or information is the basis in the identification of tasks for scheduling, the cost estimating work items or tasks are aggregated into tasks at the appropriate level for scheduling based on the purpose of the schedule</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constraint: The aggregation of the cost estimating tasks requires information on the level of detail of the cost estimating tasks and the purpose of the schedule</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description: White space</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UoB No</th>
<th>UoB Name: Identify Design Product Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects: Design product data, design document, scheduling task, resource,</td>
</tr>
<tr>
<td></td>
<td>Facts: Where the design document is the basis for the identification of scheduling tasks, product design data and information that support in the identification of tasks and resource required to perform the tasks are identified and collected</td>
</tr>
<tr>
<td></td>
<td>Constraint: The identification of product design data requires detailed product design document and specification and identification of tasks that realise the designed product and resources required to perform the task</td>
</tr>
<tr>
<td></td>
<td>Description: White space</td>
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</tbody>
</table>

CONTEXT SETTING: Aggregate Tasks & Identify Design Product Data
REFERENCE: Scenario 5
FORM TYPE: UoB elaboration
<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Identify Tasks required</th>
<th>UoB label: Identify Tasks required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects: Design data, task, product, resource, resource usage,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facts: Based on the product’s design data tasks that required to realise the product is identified</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constraint: Identification of task requires resource and resource usage information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description: White space</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UoB NO</th>
<th>UoB Name: Assign Resource</th>
<th>UoB label: Assign Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objects: Resource, task, resources requirement,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facts: Resources are identified and assigned to tasks based on the resources required to perform the task</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constraint: The assignment of resources to tasks requires resources requirement information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description: White space</td>
<td></td>
</tr>
</tbody>
</table>
**Pre-construction Scheduling Process**  
**Object View**

<table>
<thead>
<tr>
<th>DATE AT:</th>
<th>ANALYST: Genet Tesfagaber</th>
<th>WORKING</th>
<th>REVIEWER</th>
<th>DATE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT:</td>
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<td>DRAFT</td>
<td>RECOMMEND</td>
<td></td>
</tr>
<tr>
<td>NOTES</td>
<td></td>
<td>RELEASE</td>
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</tbody>
</table>

### Object State

<table>
<thead>
<tr>
<th>Object State No.</th>
<th>Object State Name:</th>
<th>Design document or tender document</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS 1</td>
<td>Label:</td>
<td>Design document or tender document</td>
</tr>
<tr>
<td></td>
<td>Transition From Object State</td>
<td>Prepared design (clients work)</td>
</tr>
<tr>
<td></td>
<td>Transition To Object State(s):</td>
<td>Task</td>
</tr>
</tbody>
</table>

### Facts:

Design document provides design and construction process information. It is a basis for design and construction process information.

### Constraints:

- **State Condition:** The design document must include all the information produced during the design process. This includes construction process information.
- **Exit Condition:** Design document requires check and inspection for completeness in specifying the product and construction process information. The specified product needs to be realised.

### Description:

<table>
<thead>
<tr>
<th>CONTEXT SETTING REFERENCE</th>
<th>ITEM DESCRIBED: Design data</th>
<th>FORM TYPE</th>
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<tbody>
<tr>
<td>Scenario 21</td>
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<td>Object State Elaboration</td>
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## Pre-construction Scheduling Process Object View

### Object State Table

<table>
<thead>
<tr>
<th>Object State No.</th>
<th>Object State Name:</th>
<th>Label:</th>
<th>Transition From</th>
<th>Transition To Object State(s):</th>
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</thead>
</table>

**Facts:** Estimating data is the items of works or tasks, resources etc used or produced during the estimating process.

**Constraints:**
- **State Condition:** The estimating data must include the attributes of the data.
- **Exit Condition:** The estimating data requires aggregation into a scheduling task.

**Other:**

**Description:**

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<thead>
<tr>
<th>CONTEXT SETTING</th>
<th>ITEM DESCRIBED</th>
<th>FORM TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCE.</td>
<td>Estimating document/data</td>
<td>Object State Elaboration</td>
</tr>
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</table>

**Scenario 21**

---

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### Task

<table>
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<tr>
<th>Scenario 21</th>
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<tbody>
<tr>
<td>Task</td>
</tr>
<tr>
<td>Object State Elaboration</td>
</tr>
</tbody>
</table>
### Appendix C

**Pre-construction Scheduling Process**  **Object View**

<table>
<thead>
<tr>
<th>DATE AT:</th>
<th>ANALYST: Gesef Tesfagaber date.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT:</td>
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<table>
<thead>
<tr>
<th>NOTES</th>
<th>REV</th>
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<tbody>
<tr>
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</table>

<table>
<thead>
<tr>
<th>Object State No.</th>
<th>Object State Name: Resources</th>
<th>Label: Resources</th>
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</table>

<table>
<thead>
<tr>
<th>Transition From Object State</th>
<th>Task</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Transition To Object State(s):</th>
<th>Time duration</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Facts:</th>
<th>Resources include labour, material, machinery, used to perform a task or construct a product</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Constraints:</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>State Condition:</th>
<th>Resources must detail all attributes</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Exit Condition:</th>
<th>Resources require time duration to perform a task or amount of work in a task</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Other:</th>
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</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Description:</th>
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<th>FORM TYPE.</th>
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<tbody>
<tr>
<td>REFERENCE:</td>
<td>Resources</td>
<td>Object State Elaboration</td>
</tr>
<tr>
<td>Scenario 21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### Object State Elaboration

<table>
<thead>
<tr>
<th>Object State Name:</th>
<th>Time duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label:</td>
<td>Time duration</td>
</tr>
<tr>
<td>Transition From</td>
<td>Resources</td>
</tr>
<tr>
<td>Object State:</td>
<td>Relationship</td>
</tr>
<tr>
<td>Transition To</td>
<td>Relationship</td>
</tr>
<tr>
<td>Object State(s):</td>
<td></td>
</tr>
</tbody>
</table>

**Facts:** Scheduling applications use time duration to calculate the amount of work to be done on the task. Time duration indicates how long a task will occur or a resources will take to perform a task.

**Constraints:**

- **State Condition:** The time duration must indicate the amount of time required to complete an amount of work in a task.

- **Exit Condition:** Time duration requires relationship between tasks and resources in order to define temporal constraints between tasks.

**Other:**

**Description:**

<table>
<thead>
<tr>
<th>CONTEXT SETTING</th>
<th>ITEM DESCRIBED</th>
<th>FORM TYPE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Time duration</td>
<td>Object State Elaboration</td>
</tr>
</tbody>
</table>

---

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Object State No.  | Object State Name: Relationship | Label: Relationship |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OS 6</td>
<td>Transition From Object State</td>
<td>Time duration</td>
</tr>
<tr>
<td></td>
<td>Transition To Object State(s):</td>
<td>Schedule</td>
</tr>
<tr>
<td>Facts:</td>
<td>Relationships are the relationships that hold between tasks based on dependence of one task with another. The relationship between tasks is the basis for calculating the start and end times of tasks</td>
<td></td>
</tr>
<tr>
<td>Constraints:</td>
<td>State Condition: The relationship must provide information on how the tasks can be linked based on the relationship</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exit Condition: Other:</td>
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</tr>
<tr>
<td>Description:</td>
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<td></td>
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<table>
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<td>REFERENCE</td>
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<td>Object State Elaboration</td>
</tr>
<tr>
<td>Scenario 21</td>
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</table>
### Appendix C

#### Pre-construction Scheduling Process Object View

<table>
<thead>
<tr>
<th>OBJECT STATE</th>
<th>ANALYST: Genet Tesfagaber</th>
<th>WORKING</th>
<th>REVIEWER</th>
<th>DATE</th>
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<tbody>
<tr>
<td></td>
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<td>DRAFT</td>
<td>RECOMMEND</td>
<td>RELEASE</td>
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<table>
<thead>
<tr>
<th>OBJECT STATE NO.</th>
<th>OBJECT STATE NAME:</th>
<th>LABEL:</th>
<th>TRANSITION FROM</th>
<th>TRANSITION TO</th>
<th>OBJECT STATE(S):</th>
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<tbody>
<tr>
<td>OS 7</td>
<td>Schedule</td>
<td>Schedule</td>
<td>Relationship</td>
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<td></td>
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</table>

**Facts:**
A schedule is a programme consists of a series of interrelated tasks with time duration assigned to it and sequenced based on the relationship and dependencies between the tasks and placed in a calendar dates with start and finish time.

**Constraints:**
- **State Condition:** A schedule must detail all the tasks their sequences, dependencies and temporal relationship between tasks, time duration and start and finish times of each task.
- **Exit Condition:** Other:

**Description:**

<table>
<thead>
<tr>
<th>CONTEXT SETTING</th>
<th>ITEM DESCRIBED:</th>
<th>FORM TYPE:</th>
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</thead>
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<td>REFERENCE:</td>
<td>Schedule</td>
<td>Object State Elaboration</td>
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**Scenario 21**

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Appendices D

Ontology of the IDEF3 Models

Appendix D

Ontology Representations of the IDEF3 Models

<table>
<thead>
<tr>
<th>Process Definition</th>
<th>Pages</th>
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</thead>
<tbody>
<tr>
<td>Produce and Manage Building Process</td>
<td>447</td>
</tr>
<tr>
<td>Produce and manage Architectural Design Data Process</td>
<td>462</td>
</tr>
<tr>
<td>Pre-tender Procedure</td>
<td>502</td>
</tr>
<tr>
<td>Plan and Schedule Process</td>
<td>519</td>
</tr>
</tbody>
</table>
Appendix D  produce & Manage Building Process Ontology

(doc construction-process "Construction-Process")

(and (doc construction-process "The Top Level Construction-process schematic")
  (and (subactivity construction-process-1 construction-process)
    (idef-process construction-process)))

(and (doc construction-process-1
  "The occurrence of Construction-Process in the schematic")
  (and (forall ?a
    (=> activation of ?a construction-process-1)
    (activation of ?a construction-process)))
  (and (forall ?a
    (=> activation of ?a construction-process-1)
    (activation of ?a decomposition-0 1))))

(and (doc decomposition-0 1 "Decomposition of Construction-Process")
  (and (subactivity produce-and-manage-bldg-process-1 decomposition-0 1)
    (and (subactivity produce-and-manage-architectural-design-data -1 decomposition-0.1)
      (and (subactivity produce-and-manage-structural-design-data -1 decomposition-0.1)
        (and (subactivity produce-and-manage-service-design-data -1 decomposition-0.1)
          (and (doc J1 "J1")
            (and (forall ?j
              (=>(activation-of ?j J1)
                (exists ?p
                  (=>(activation-of ?p decomposition 0.1)
                    (subactivity-occurrence ?j ?p)))
                (and (and_split J1 decomposition 1 1)
                  (and (subactivity produce-&-manage-building-process J1)
                    (and (subactivity produce-&-manage-architectural-design-data J1)
                      (and (subactivity produce-&-manage-structural-design-data J1)
                        (and (doc J1 "J1")
                          (and (subactivity produce-&-manage-geotechnical-design-data J1)
                            (and (subactivity implement-building
                             J1)))))))))))

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Appendix D  
*produce & Manage Building Process Ontology*

(and (doc J2 "J2")
 (and (forall ?J
  (=>(activation-of ?J J2)
   (exists ?p
    (=>(activation-of ?p decomposition 0 1)
     (subactivity-occurrence ?J ?p)))))
  (and (follows J2 implement-building decomposition 1.1)
   (and (and_split J2 decomposition 1.1)
    (and (subactivity produce-&-manage-building-process J2)
     (and (subactivity produce-&-manage-architectural-design-data J2)
      (and (subactivity produce-&-manage-structural-design-data J2)
       (and (subactivity produce-&-manage-geotechnical-data J2)))))))))

(and (doc produce-and-manage-bldg-process-l
  ("The occurrence of produce-&-manage-bldg-process in the Dec-0 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a produce and manage bldg process-1)
     (activation-of ?a produce and manage bldg process)))
    (and (forall ?a
    (=>(activation-of ?a produce and manage bldg process-1)
     (exists ?p
      (=>(activation-of ?p decomposition-0 1)
       (subactivity-occurrence ?a ?p))))))

  (forall ?a
   (=>(activation-of ?a produce and manage bldg process-1)
    (activation-of ?a decomposition 101.1))))))

(and (doc decomposition-101.1 "Decomposition of Produce and Manage Bldg process")
 (and (subactivity draw-up-brief-1 decomposition-101.1)
  (and (subactivity no-project -1 decomposition-101.1)
   (and (subactivity draw-up-programme-1 decomposition-101.1)
    (and (subactivity prepare-for-design-1 decomposition-101.1)
     (and (subactivity supervise-design-1 decomposition-101.1)
      (and (subactivity prepare-for-construction-1 decomposition-101.1)
       (and (subactivity supervise-construction-1 decomposition-101.1)
        (and (subactivity Jl decomposition-101.1)
         (idef-process decomposition-101.1))))))))

(and (doc draw-up-brief-1
  ("The occurrence of Draw-Up-Brief in the Dec-101.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a draw-up-brief-1)
     (activation-of ?a draw-up-brief)))
    (and (forall ?a
    (=>(activation-of ?a draw-up-brief-1)
     (exists ?p
      (=>(activation-of ?p decomposition 101 1)
       (subactivity-occurrence ?a ?p))))))

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(forall ?a
  (=>(activation-of ?a draw-up-brief-1)
      (activation-of ?a decomposition107.1))))

(and (doc make-no-change-required-decision -1
      "The occurrence of Make-Change-Requested-Decision in the Dec-101 1 schematic")
    (forall ?a
     (=>(activation-of ?a make-no-change-required-decision -1)
        (activation-of ?a Dec-101 1 schematics))))

(and forall ?a
  (=>(activation-of ?a Dec-101.1 schematics")-1)
  (exists ?p
   (=> (activation-of ?p decomposition 101.1)
        (subactivity-occurrence ?a ?p))))))

(and (doc draw-up-programme-I
      "The occurrence of Draw-Up-Programme in the Dec-101 1 schematic")
    (forall ?a
     (=>(activation-of ?a draw-up-programme -I)
         (activation-of ?a draw-up-programme)))
    (forall ?a
     (=>(activation-of ?a draw-up-programme -I)
         (exists ?p
          (=> (activation-of ?p decomposition 101.1)
              (subactivity-occurrence ?a ?p))))
     (forall ?a
      (=>(activation-of ?a draw-up programme-1)
          (activation-of ?a decomposition109 1))))))

(and (doc prepare-for-design-I
      "The occurrence of Prepare-for-Design in the Dec-101.1schematic")
    (forall ?a
     (=>(activation-of ?a prepare-for-design -I)
         (activation-of ?a prepare-for-design)))
    (forall ?a
     (=>(activation-of ?a prepare-for-design -I)
         (exists ?p
          (=> (activation-of ?p decomposition 101 1)
              (subactivity-occurrence ?a ?p))))
     (forall ?a
      (=>(activation-of ?a prepare-for-design -I)
          (activation-of ?a decomposition110 1))))))

(and (doc supervise-design-I
      "The occurrence of Supervise-Design in the Dec-101 1 schematic")
    (forall ?a
     (=>(activation-of ?a supervise-design -I)
         (activation-of ?a supervise-design)))
    (forall ?a
     (=>(activation-of ?a supervise-design -I)
         (exists ?p
          (=> (activation-of ?p decomposition 101 1)
              (subactivity-occurrence ?a ?p))))))

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(forall ?a
  (=>(activation-of ?a supervise design -1)
    (activation-of ?a decomposition111.1))))

(and (doc prepare-for-construction-1
  "The occurrence of Prepare-for-Construction in the Dec-101 1 schematics")
  (and (forall ?a
    (=>(activation-of ?a prepare-for-construction -1)
      (activation-of ?a prepare-for-construction)))
  (and (forall ?a
    (=>(activation-of ?a prepare-for-construction -1)
      (exists ?p
        (=> (activation-of ?p decomposition 101.1)
          (subactivity-occurrence ?a ?p)))))
  (forall ?a
    (=>(activation-of ?a prepare for construction -1)
      (activation-of ?a decomposition112.1))))

(and (doc supervise-construction-1
  "The occurrence of Supervise-Construction in the Dec-101 1 schematics")
  (and (forall ?a
    (=>(activation-of ?a supervise construction -1)
      (activation-of ?a supervise construction)))
  (and (forall ?a
    (=>(activation-of ?a supervise construction -1)
      (exists ?p
        (=> (activation-of ?p decomposition 101.1)
          (subactivity-occurrence ?a ?p)))))
  (forall ?a
    (=>(activation-of ?a supervise construction -1)
      (activation-of ?a decomposition113.1))))

(and (doc j1 "J1")
  (and (forall ?j
    (=>(activation-of ?j j1)
      (exists ?p
        (=>(activation-of ?p decomposition 0.1)
          (subactivity-occurrence ?j ?p)))))
  (and (follows draw-up-brief j1 decomposition-101.1)
    (and (and_split j1 decomposition 101.1)
      (and (subactivity make-no-change-required-decision j2)
        (subactivity draw-up-programme j2))))

(and (doc decomposition-107 1 "Decomposition of Draw-Up-Brief")
  (and (subactivity define-requirement-1 decomposition-107 1)
    (and (subactivity determine-space-acquisition-alternatives-1 decomposition-107 1)
      (def-process decomposition-0 1))))
Appendices D produce & Manage Building Process Ontology

(and (doc define-requirements-1
  "The occurrence of Define Requirements in the Dec-101.1 schematic")
(and (forall ?a
  (=>(activation-of ?a define-requirements-1)
    (activation-of ?a define-requirements)))
(forall ?a
  (=>(activation-of ?a define-requirements-1)
    (exists ?p
     (=> (activation-of ?p decomposition 107.1)
      (subactivity-occurrence ?a ?p))))))

(and (doc determine-space-acquisition-alternatives -1
  "The occurrence of Determine-Space-Acquisition-Alternatives in the Dec-101 1")

(and (forall ?a
  (=>(activation-of ?a determine-space-acquisition-alternatives -1)
    (activation-of ?a determine-space-acquisition-alternatives)))
(forall ?a
  (=>(activation-of ?a determine-space-acquisition-alternatives -1)
    (exists ?p
     (=> (activation-of ?p decomposition 107.1)
      (subactivity-occurrence ?a ?p))))))

(and (doc prepare-decision-for-programme -1
  "The occurrence of Prepare-Decision- for-Programme in the Dec-101 1 schematic")
(and (forall ?a
  (=>(activation-of ?a prepare-decision-for-programme-1)
    (activation-of ?a prepare-decision-for-programme)))
(forall ?a
  (=>(activation-of ?a prepare-decision-for-programme-1)
    (exists ?p
     (=> (activation-of ?p decomposition 107.1)
      (subactivity-occurrence ?a ?p))))))

(and (doc decomposition-109 1 “Decomposition of Draw-Up-Programme”)
  (and (subactivity define-requirements-1 decomposition-109 1)
    (and (subactivity clear-bldg-site-building-permit -1 decomposition-109.1)
      (and (subactivity draw-up-space-programme- &-other-requirements-1 decomposition-109 1)
        (and (subactivity plan-schedule- &-mode-of-operation -1 decomposition-109.1)
          (and (subactivity set-cost-objectives -1 decomposition-109.1)
            (and (subactivity prepare-investment-decision-1 decomposition-109 1)
              (and (subactivity J1 decomposition-109.1)
                (and (subactivity J2 decomposition-109 1)
                  (idef-process decomposition-109 1))))))))

(and (doc define-requirements-1
  "The occurrence of Define-Requirements in the Dec-101.1 schematic")
(and (forall ?a
  (=>(activation-of ?a define-requirements -1)
    (activation-of ?a define-requirements))

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(forall ?a
  (=>(activation-of ?a define-requirements -1)
      
      (exists ?p
       (=>(activation-of ?p decomposition 109 1)
            
            (subactivity-occurrence ?a ?p)))))

(and (doc clear-bldg-site-&-building-permit -1 “The occurrence of Clear-Bldg-Site-&-Building Permit in the Dec-109.1 schematics”)
  (and (forall ?a
         (=>(activation-of ?a clear-bldg-site-&-building-permit -1)
             
             (activation-of ?a clear-bldg-site-&-building-permit)))

  (forall ?a
   (=>(activation-of ?a clear-bldg-site-&-building-permit -1)
       
       (exists ?p
        (=>(activation-of ?p decomposition 109 1)
             
             (subactivity-occurrence ?a ?p)))))

(and (doc draw-up-space-programme-&-other-requirements -1
      “The occurrence of Draw-up-Space-Programme-&-Other-Requirements in the Dec-109.1 schematic”)
  (and (forall ?a
         (=>(activation-of ?a draw-up-space-programme-&-other-requirements -1)
             
             (activation-of ?a draw-up-space-programme-&-other-requirements)))

  (forall ?a
   (=>(activation-of ?a draw-up-space-programme-&-other-requirements -1)
       
       (exists ?p
        (=>(activation-of ?p decomposition 109.1)
             
             (subactivity-occurrence ?a ?p)))))

(and (doc plan-schedule-&-mode-of-operation -1
      “The occurrence of Plan-Schedule-&-Mode-of-Operation in the Dec-101.1 schematic”)
  (and (forall ?a
         (=>(activation-of ?a plan-schedule-&-mode-of-operation -1)
             
             (activation-of ?a plan-schedule-&-mode-of-operation)))

  (forall ?a
   (=>(activation-of ?a plan-schedule-&-mode-of-operation -1)
       
       (exists ?p
        (=>(activation-of ?p decomposition 109 1)
             
             (subactivity-occurrence ?a ?p)))))

(and (doc set-cost-objectives -1
      “The occurrence of Set-Cost-Objectives in the Dec-109.1 schematic”)
  (and (forall ?a
         (=>(activation-of ?a set-cost-objectives -1)
             
             (activation-of ?a set-cost-objectives)))

  (forall ?a
   (=>(activation-of ?a set-cost-objectives -1)
       
       (exists ?p
        (=>(activation-of ?p decomposition 109.1)
             
             (subactivity-occurrence ?a ?p))))))
(and (doc prepare-investment-decision-1
   "The occurrence of Prepare-Investment-Decision in the Dec-109 1 schematic")
   (and forall ?a
       (=>(activation-of ?a prepare-investment-decision-1)
           (activation-of ?a prepare-investment-decision)))

   (forall ?a
       (=>(activation-of ?a prepare-investment-decision-1)
           (exists ?p
               (=> (activation-of ?p decomposition 109.1)
                   (subactivity-occurrence ?a ?p)))))

   (and (doc J1 "J1")
       (and (forall ?J
               (=>(activation-of ?J J1)
                   (exists ?p
                       (=>(activation-of ?p decomposition 109.1)
                           (subactivity-occurrence ?J ?p)))))
           (and (and_split J1 decomposition 109.1)
               (and (subactivity define-requirements J1)
                   (and (subactivity clear-building-site-&-building-permit J1))))))

   (and (doc J2 "J2")
       (and (forall ?J
               (=>(activation-of ?J J2)
                   (exists ?p
                       (=>(activation-of ?p decomposition 109.1)
                           (subactivity-occurrence ?J ?p)))))
           (and (follows J2 set-cost-objectives decomposition-109.1)
               (and (and_split J2 decomposition 109.1)
                   (and (subactivity draw-up-space-programme-&-other-requirements J2)
                       (and (subactivity plan-schedule-&-mode-of-operation J2))))))

   (and (doc decomposition-110 1 "Decomposition of Prepare for Desing")
       (and (subactivity organise design work-1 decomposition-110 1)
           (and (subactivity select desingers-1 decomposition-110 1)
               (and (subactivity conclude design contract-1 decomposition-110 1)
                   (idef-process decomposition-110 1)))))

   (and (doc organise-design-work-1
       "The occurrence of Organise-Design-Work in the Dec-110 1 schematic")
       (and forall ?a
           (=>(activation-of ?a organise-design-work-1)
               (activation-of ?a organise-design-work)))

       (forall ?a
           (=>(activation-of ?a organise-design-work-1)
               (exists ?p
                   (=> (activation-of ?p decomposition 110 1)
                       (subactivity-occurrence ?a ?p)))))

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(and (doc select-designers -1
    "The occurrence of Select-Designers in the Dec-110 1")
(and (forall ?a
    (=>(activation-of ?a select-designers -1)
        (activation-of ?a select-designers)))
(and forall ?a
    (=>(activation-of ?a select-designers -1)
        (exists ?p
            (=> (activation-of ?p decomposition 110 1)
                (subactivity-occurrence ?a ?p))))))

(forall ?a
    (=>(activation-of ?a select-designers -1)
        (activation-of ?a decomposition124 1))))

(and (doc decomposition-124 1 "Decomposition of Select Designers")
    (and (subactivity decide-on-selection-method-1 decomposition-124.1)
        (and (subactivity invite-designers-directly-1 decomposition-124 1)
            (and (subactivity negotiate-with-candidate-designers-1 decomposition-124 1)
                (and (subactivity invite-designers-to-tender-1 decomposition-124 1)
                    (and (subactivity select designer-1 decomposition-124.1)
                        (and (subactivity J1 decomposition-124 1)
                            (and (subactivity J2 decomposition-124.1)
                                (idef-process decomposition-124 1))))))

(and (doc make-decision-on-selection-method-1
    "The occurrence of Make-Decision-On-Selection-Method in the Dec-124 1 schematic")
    (and (forall ?a
        (=>(activation-of ?a make-decision-on-selection-method-1)
            (activation-of ?a make-decision-on-selection-method))
        (forall ?a
            (=>(activation-of ?a make-decision-on-selection-method-1)
                (exists ?p
                    (=> (activation-of ?p decomposition 124.1)
                        (subactivity-occurrence ?a ?p))))))

(and (doc invite-designers-directly -1
    "The occurrence of Invite-Designers-Directly in the Dec-124.1schematic")
    (and (forall ?a
        (=>(activation-of ?a invite-designers-directly -1)
            (activation-of ?a invite-designers-directly))
        (forall ?a
            (=>(activation-of ?a invite-designers-directly -1)
                (exists ?p
                    (=> (activation-of ?p decomposition 124 1)
                        (subactivity-occurrence ?a ?p))))))
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(and (doc negotiate-with-candidate-designers -1
   “The occurrence of Negotiate-With-Candidate-Designers in the Dec-124.1 schematic”) (and (forall ?a
       (=>(activation-of ?a negotiate-with-candidate-designers-1)
           (activation-of ?a negotiate-with-candidate-designers-1)))
   (forall ?a
       (=>(activation-of ?a negotiate-with-candidate-designers-1)
           (exists ?p
            (=> (activation-of ?p decomposition 124.1)
                (subactivity-occurrence ?a ?p))))))

(and (doc invite-designers-to-tender-1 “The occurrence of Invite-Designers-to-Tender in the Dec-124.1 schematic”) (and (forall ?a
       (=>(activation-of ?a invite-designers-to-tender -1)
           (activation-of ?a invite-designers-to-tender-1)))
   (forall ?a
       (=>(activation-of ?a invite-designers-to-tender-1)
           (exists ?p
            (=> (activation-of ?p decomposition 124.1)
                (subactivity-occurrence ?a ?p))))))

(and (doc invite-designers-for-competition-1 “The occurrence of Invite-Designers-for-Competition in the Dec-124.1 schematic”) (and (forall ?a
       (=>(activation-of ?a invite-designers-for-competition-1)
           (activation-of ?a invite-designers-for-competition-1)))
   (forall ?a
       (=>(activation-of ?a invite-designers-for-competition-1)
           (exists ?p
            (=> (activation-of ?p decomposition 124.1)
                (subactivity-occurrence ?a ?p))))))

(and (doc select-designer-1 “The occurrence of select-designer in the Dec-124.1 schematic”) (and (forall ?a
       (=>(activation-of ?a select-designer -1)
           (activation-of ?a select-designer-1)))
   (forall ?a
       (=>(activation-of ?a select-designer-1)
           (exists ?p
            (=> (activation-of ?p decomposition 124.1)
                (subactivity-occurrence ?a ?p))))))

(and (doc j1 “J1”) (and (forall ?j
       (=>(activation-of ?j j1)
           (exists ?p
            (=>(activation-of ?p decomposition 124.1)
                (subactivity-occurrence ?j ?p))))))
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(and (follows make-decision-on-selection-method j1 decomposition-124 I)
  (and (and_split j2 decomposition 124 I)
    (and (subactivity invite-designers-directly j1)
      (and (subactivity negotiate-with-candidate-designers j1)
        (and (subactivity invite-designers-to-tender j1)
          (and (subactivity invite-candidate-designers-for-competition j1)))))))

(and (doc j2 "J2")
  (and (forall ?j
        (=>(activation-of ?j j2)
            (exists ?p
              (=>(activation-of ?p decomposition 124.1)
                  (subactivity-occurrence ?j ?p)))))
    (and (follows j2 select-designer-124 I)
      (and (and_split j2 decomposition 124 I)
        (and (subactivity invite-designers-directly j1)
          (and (subactivity negotiate-with-candidate-designers j1)
            (and (subactivity invite-designers-to-tender j1)
              (and (subactivity invite-candidate-designers-for-competition j1)))))))

(and (doc decomposition-111 I "Decomposition of Supervise Designer")
  (and (subactivity start-design-1 decomposition-111 I)
    (and (subactivity supervise-design-1 decomposition-111 I)
      (and (subactivity compare-design-solutions-1 decomposition-111 I)
        (and (subactivity check-&-evaluate-design-1 decomposition-111.1)
          (and (subactivity get-design-approved-1 decomposition-111 I)
            (and (subactivity control-acquisition-of-permits-1 decomposition-111.1)
              (and (subactivity J1 decomposition-111 I)
                (and (subactivity J2 decomposition-111 I)
                  (i_def-process decomposition-111.1))))))))

(and (doc start-design -1
      "The occurrence of start-design in the Dec-111.1 schematic")
  (and (forall ?a
        (=>(activation-of ?a start-design -1)
            (activation-of ?a start-design)))
    (forall ?a
      (=>(activation-of ?a start-design -1)
        (exists ?p
          (=>(activation-of ?p decomposition 111 I)
            (subactivity-occurrence ?a ?p))))))

(and (doc supervise-design -1
      "The occurrence of supervise-design in the Dec-111 1 schematic")
  (and (forall ?a
        (=>(activation-of ?a supervise-design -1)
            (activation-of ?a supervise-design))))
(forall ?a
  (implies (activation-of ?a supervise-design-1)
    (exists ?p
      (implies (activation-of ?p decomposition 111 1)
        (subactivity-occurrence ?a ?p)))))

(and (doc compare-design-solutions -1
  "The occurrence of compare-design-solutions in the Dec-111 1 schematic")
  (forall ?a
    (implies (activation-of ?a compare-design-solutions -1)
      (activation-of ?a compare-design-solutions)))

  (forall ?a
    (implies (activation-of ?a compare-design-solutions -1)
      (exists ?p
        (implies (activation-of ?p decomposition 111 1)
          (subactivity-occurrence ?a ?p)))))

(and (doc check-&-evaluate-design -1
  "The occurrence of check-&-evaluate-design in the Dec-111.1 schematic")
  (forall ?a
    (implies (activation-of ?a check-&-evaluate-design -1)
      (activation-of ?a check-&-evaluate-design)))

  (forall ?a
    (implies (activation-of ?a check-&-evaluate-design -1)
      (exists ?p
        (implies (activation-of ?p decomposition 111 1)
          (subactivity-occurrence ?a ?p)))))

(and (doc get-design-approved -1
  "The occurrence of get-design-approved in the Dec-111.1 schematic")
  (forall ?a
    (implies (activation-of ?a get-design-approved -1)
      (activation-of ?a get-design-approved)))

  (forall ?a
    (implies (activation-of ?a get-design-approved -1)
      (exists ?p
        (implies (activation-of ?p decomposition 111 1)
          (subactivity-occurrence ?a ?p)))))

(and (doc control-acquisition-of-permits -1
  "The occurrence of control-acquisition-of-permits in the Dec-111 1 schematic")
  (forall ?a
    (implies (activation-of ?a control-acquisition-of-permits -1)
      (activation-of ?a control-acquisition-of-permits)))

  (forall ?a
    (implies (activation-of ?a control-acquisition-of-permits -1)
      (exists ?p
        (implies (activation-of ?p decomposition 110 1)
          (subactivity-occurrence ?a ?p)))))
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(and (doc j1 "J1")
  (and (forall ?J
    (=>(activation-of ?J j1)
     (exists ?p
      (=>(activation-of ?p decomposition 111 1)
       (subactivity-occurrence ?J ?p)))))
    (and (follows start-design j1 decomposition 111 1)
     (and (and_split j1 decomposition 111.1)
      (and (subactivity supervise-design j1)
       (and (subactivity compare-design-solutions j1)))))

(and (doc j2 "J2")
  (and (forall ?J
    (=>(activation-of ?J j2)
     (exists ?p
      (=>(activation-of ?p decomposition 111 1)
       (subactivity-occurrence ?J ?p))))
    (and (follows j2 check-and-evaluate-design decomposition 111.1)
     (and (and_split j2 decomposition 111 1)
      (and (subactivity supervise-design j2)
       (and (subactivity compare-design-solutions j2))))))

(and (doc decomposition-112 1 "Decomposition of Prepare for Construction")
  (and (subactivity select-mode-of-operation-1 decomposition-112 1)
   (and (subactivity prepare-invitation-to-tender-1 decomposition-112 1)
    (and (subactivity prepare-for-selection-of-contractors -1 decomposition-112 1)
     (and (subactivity make-construction-decision-1 decomposition-112 1)
      (and (subactivity conclude-contract-1 decomposition-112 1)
       (and (subactivity manage-procurements-of-client-1 decomposition-112 1)
        (def-process decomposition-112 1))))))

(and (doc select-mode-of-operation -1
  "The occurrence of Select-Mode-of-Operation in the Dec-112 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a select-mode-of-operation -1)
     (activation-of ?a select-mode-of-operation)))

(forall ?a
  (=>(activation-of ?a select-mode-of-operation -1)
   (exists ?p
    (=> (activation-of ?p decomposition 112.1)
     (subactivity-occurrence ?a ?p)))))

(and (doc prepare-invitation-to-tender -1
  "The occurrence of Prepare-Invitation-to-Tender in the Dec-112.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a prepare-invitation-to-tender-1)
     (activation-of ?a prepare-invitation-to-tender)))

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(forall ?a
  (=>(activation-of ?a prepare-invitation-to-tender-1)
      (exists ?p
       (=> (activation-of ?p decomposition 112 1)
            (subactivity-occurrence ?a ?p)))))

(and (doc prepare-for-selection-of-contractors-1
  "The occurrence of Prepare-for-Selection-of-Contractors in the Dec-112 1")
  (forall ?a
   (=>(activation-of ?a prepare-for-selection-of-contractors-1)
       (activation-of ?a prepare-for-selection-of-contractors-1)))

(forall ?a
  (=>(activation-of ?a prepare-for-selection-of-contractors-1)
      (exists ?p
       (=> (activation-of ?p decomposition 112 1)
            (subactivity-occurrence ?a ?p)))))

(and (doc make-construction-decision -1
  "The occurrence of Make-Construction-Decision in the Dec-112 1 schematic")
  (forall ?a
   (=>(activation-of ?a make-construction-decision-1)
       (activation-of ?a make-construction-decision-1)))

(forall ?a
  (=>(activation-of ?a make-construction-decision-1)
      (exists ?p
       (=> (activation-of ?p decomposition 112 1)
            (subactivity-occurrence ?a ?p)))))

(and (doc conclude-contract-1
  "The occurrence of Conclude-Contract in the Dec-112 1")
  (forall ?a
   (=>(activation-of ?a conclude-contract-1)
       (activation-of ?a conclude-contract-1)))

(forall ?a
  (=>(activation-of ?a conclude-contract-1)
      (exists ?p
       (=> (activation-of ?p decomposition 112.1)
            (subactivity-occurrence ?a ?p)))))

(and (doc manage-procurements-of-clients-1
  "The occurrence of Manage-Procurements-of-Clients in the Dec-112.1 schematic")
  (forall ?a
   (=>(activation-of ?a manage-procurements-of-clients-1)
       (activation-of ?a manage-procurements-of-clients-1)))

(forall ?a
  (=>(activation-of ?a manage-procurements-of-clients-1)
      (exists ?p
       (=> (activation-of ?p decomposition 112 1)
            (subactivity-occurrence ?a ?p)))))

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(and (doc decomposition-113.1 "Decomposition of Supervise Construction")
  (and (subactvity supervise-and-control-construction-1 decomposition-113 1)
    (and (subactvity supervise-subcontracting-1 decomposition-113 1)
      (and (subactvity manage-payment-1 decomposition-113 1)
        (and (subactvity do-additional-work-and-modifications-1 decomposition-113 1)
          (and (subactvity manage-special-cases-1 decomposition-113 1)
            (and (subactvity 1 decomposition-113 1)
              (idef-process decomposition-113.1)))
  )))

(and (doc supervise-and-control-construction -1
  "The occurrence of Supervise-and-Control-Construction in the Dec-113 1 schematic")
  (and (forall ?a
    (=>(actlvation-of ?a supervise-and-control-construction -1)
      (activation-of ?a supervise-and-control-construction)))
  (forall ?a
    (=>(actlvation-of ?a supervise-and-control-construction -1)
      (exists ?p
       (=> (activation-of ?p decomposition 113 1)
            (subactivity-occurrence ?a ?p)))))

(and (doc supervise-subcontracting -1
  "The occurrence of Supervise-Subcontracting in the Dec-113 1 schematic")
  (and (forall ?a
    (=>(actlvation-of ?a supervise-subcontracting -1)
      (activation-of ?a supervise-subcontracting)))
  (forall ?a
    (=>(actlvation-of ?a supervise-subcontracting -1)
      (exists ?p
       (=> (activation-of ?p decomposition 113 1)
            (subactivity-occurrence ?a ?p)))))

(and (doc manage-payment-1
  "The occurrence of Manage-Payment in the Dec-113 1 schematic")
  (and (forall ?a
    (=>(actlvation-of ?a manage-payment-1)
      (activation-of ?a manage-payment)))
  (forall ?a
    (=>(actlvation-of ?a manage-payment-1)
      (exists ?p
       (=> (activation-of ?p decomposition 113.1)
            (subactivity-occurrence ?a ?p)))))

(and (doc do-additional-work-&-modifications-1
  "The occurrence of Do-Additional-Work-&-Modification in the Dec-113 1 schematic")
  (and (forall ?a
    (=>(actlvation-of ?a do-additional-work-&-modifications-1)
      (activation-of ?a do-additional-work-&-modifications))))

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(forall ?a
  (=> (activation-of ?a do-additional-work-&-modifications-1)
    (exists ?p
      (=> (activation-of ?p decomposition 113 1)
        (subactivity-occurrence ?a ?p)))))

(and (doc manage-acquisitions-of-builder-1
   "The occurrence of Manage-Acquisitions-of-Builder in the Dec-113.1 schematic")
  (forall ?a
    (=> (activation-of ?a manage-acquisitions-of-builder -1)
      (activation-of ?a manage-acquisitions-of-builder)))

(forall ?a
  (=> (activation-of ?a manage-acquisitions-of-builder -1)
    (exists ?p
      (=> (activation-of ?p decomposition 113 1)
        (subactivity-occurrence ?a ?p)))))

(and (doc manage-special cases-1
   "The occurrence of Manage-Special-Cases in the Dec-113 1 schematic")
  (forall ?a
    (=> (activation-of ?a manage-special cases -1)
      (activation-of ?a manage-special cases)))

(forall ?a
  (=> (activation-of ?a manage-special cases -1)
    (exists ?p
      (=> (activation-of ?p decomposition 113.1)
        (subactivity-occurrence ?a ?p)))))

(and (doc j1 "J1")
  (forall ?j
    (=> (activation-of ?j j1)
      (exists ?p
        (=> (activation-of ?p decomposition 112 1)
          (subactivity-occurrence ?j ?p)))))

(and (follows supervise-&-control-construction J1 decomposition112.1)
  (and (and_split j1 decomposition 112.1)
    (and (subactivity supervise-subcontracting J1)
      (and (subactivity manage-payment j1)
        (and (subactivity do-additional-work-&-modification j1)
          (and (subactivity manage-acquisition-of-builders j1)
            (and (subactivity manage-special-cases j1))))))))
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(and (doc produce-and-manage-arch-design-data-1
  "The occurrence of Produce and Manage Arch Design Data in the Dec-0.1 schematics")
  (and (forall ?a
    (=> (activation-of ?a produce-and-manage-arch-design-data-1)
        (activation-of ?a produce-and-manage-arch-design-data)))
  (and (forall ?a
    (=>(activation-of ?a produce-and-manage-arch-design-data-1)
        (exists ?p
            (=> (activation-of ?p decomposition-0 1)
                (subactivity-occurrence ?a ?p)))))
  (forall ?a
    (=>(activation-of ?a produce and manage bldg process-1)
        (activation-of ?a decomposition 102 1)))))

(and (doc decomposition-102 1 "Decomposition of Produce and Manage Arch Design Data")
  (and (forall ?a
    (=> (activation-of ?a decomposition-102 1)
        (activation-of ?a decomposition-102.1)))
  (and (forall ?a
    (=> (activation-of ?a decomposition-102 1)
        (exists ?p
            (=> (activation-of ?p decomposition-102.1)
                (subactivity-occurrence ?a ?p)))))
  (forall ?a
    (=>(activation-of ?a decomposition 102 1)
        (activation-of ?a decomposition 102.1)
        (def-process decomposition-102 1))))

(and (doc draw-up-brief-1 "The occurrence of Draw up Brief in the Dec-102 1 schematic")
  (and (forall ?a
    (=> (activation-of ?a draw-up-brief-1)
        (activation-of ?a draw-up-brief)))
  (and (forall ?a
    (=>(activation-of ?a draw-up-brief-1)
        (exists ?p
            (=> (activation-of ?p decomposition 102.1)
                (subactivity-occurrence ?a ?p)))))
  (forall ?a
    (=>(activation-of ?a draw-up-brief-1)
        (activation-of ?a decomposition-113 1)))))

(and (doc draw-up-programme-1 "The occurrence of Draw Up Programme in the Dec-102 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a draw-up-programme-1)
        (activation-of ?a draw-up-programme)))
  (and (forall ?a
    (=>(activation-of ?a draw-up-programme-1)
        (exists ?p
            (=> (activation-of ?p decomposition 102 1)
                (subactivity-occurrence ?a ?p)))))
  (forall ?a
    (=>(activation-of ?a draw-up-programme-1)
        (activation-of ?a decomposition-113 1)))))
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(forall ?a
  (=>(activation-of ?a draw-up-programme -1)
      (activation-of ?a decomposition114 I))))

(and (doc make-overall-design -1
  "The occurrence of make-overall-design in the Dec-102 1 schematic")
  (and (forall ?a
         (=>(activation-of ?a make-overall-design -1)
             (exists ?p
              (=> (activation-of ?p decomposition 102 1)
                   (subactivity-occurrence ?a ?p)))))
         (forall ?a
          (=>(activation-of ?a make-overall-design -1)
              (activation-of ?a decomposition115 I))))

(and (doc make-detail-design -1
  "The occurrence of Make-Detail-Design in the Dec-102 1 schematic")
  (and (forall ?a
         (=>(activation-of ?a make-detail-design -1)
             (exists ?p
              (=> (activation-of ?p decomposition 102 1)
                   (subactivity-occurrence ?a ?p)))))
         (forall ?a
          (=>(activation-of ?a make-detail-design -1)
              (activation-of ?a decomposition116 I))))

(and (doc make-design-during-construction -1
  "The occurrence of Make Design during Construction in the Dec-102.1 schematic")
  (and (forall ?a
         (=>(activation-of ?a make-design-during-construction -1)
             (activation-of ?a make-design-during-construction)))
         (forall ?a
          (=>(activation-of ?a make-design-during-construction -1)
              (exists ?p
               (=> (activation-of ?p decomposition 102 1)
                   (subactivity-occurrence ?a ?p))))))
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(and (doc do-tasks-during-use-&-maintenance -1
  "The occurrence of Do Tasks During Use & Maintenance in the Dec-102 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a do-tasks-during-use-&-maintenance-1)
      (activation-of ?a do-tasks-during-use-&-maintenance)))
    (and (forall ?a
      (=>(activation-of ?a do-tasks-during-use-&-maintenance-1)
        (exists ?p
          (=> (activation-of ?p decomposition 102 1)
            (subactivity-occurrence ?a ?p)))))
      (forall ?a
        (=>(activation-of ?a do-tasks-during-use-&-maintenance-1)
          (activation-of ?a decomposition118 1))))))

(and (doc decomposition-113.1 "Decomposition of Draw up Brief")
  (and (subactivity analyse-present-situation-1 decomposition-113 1)
    (and (subactivity define-requirements-1 decomposition-113 1)
      (and (subactivity determine-space-acquisition-alternatives-1 decomposition-113 1)
        (and (subactivity prepare-programme-decision-1 decomposition-113 1)
          (iddef-process decomposition-113 1))))))

(and (doc analyse-present-situation -1
  "The occurrence of Analyse Present Situation in the Dec-113.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a analyse-present-situation -1)
      (activation-of ?a analyse-present-situation)))
    (forall ?a
      (=>(activation-of ?a analyse-present-situation -1)
        (exists ?p
          (=> (activation-of ?p decomposition 113 1)
            (subactivity-occurrence ?a ?p))))))

(and (doc define-requirements -1
  "The occurrence of Define Requirements in the Dec-113 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a define-requirements -1)
      (activation-of ?a define-requirements)))
    (forall ?a
      (=>(activation-of ?a define-requirements -1)
        (exists ?p
          (=> (activation-of ?p decomposition 113 1)
            (subactivity-occurrence ?a ?p))))))

(and (doc determine-space-acquisition-alternatives-1
  "The occurrence of Determine Space Acquisition Alternatives in the Dec-113 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a determine-space-acquisition-alternatives -1)
      (activation-of ?a determine-space-acquisition-alternatives))))

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(forall ?a
  (=>(activation-of ?a determine-space-acquisition-alternatives -1)
      (exists ?p
       (=> (activation-of ?p decomposition 113 1)
            (subactivity-occurrence ?a ?p))))))

(and (doc prepare-programme-decision -1
      “The occurrence of Prepare Programme Decision in the Dec-113 1 schematic”)
    (forall ?a
     (=>(activation-of ?a prepare-programme-decision-1)
         (activation-of ?a prepare-programme-decision)))

(forall ?a
  (=>(activation-of ?a prepare-programme-decision -1)
      (exists ?p
       (=> (activation-of ?p decomposition 113 1)
            (subactivity-occurrence ?a ?p))))))

(and (doc decomposition-114 1 “Decomposition of Draw up Programme”)
    (forall ?a
     (=>(activation-of ?a define-requirements -1)
         (activation-of ?a define-requirements)))

(forall ?a
  (=>(activation-of ?a define-requirements -1)
      (exists ?p
       (=> (activation-of ?p decomposition 114 1)
            (subactivity-occurrence ?a ?p))))))

(and (doc clear-site-&-bldg-permits-1
      “The occurrence of Clear site & Bldg Permits in the Decomposition-114 1 schematic”)
    (forall ?a
     (=>(activation-of ?a clear-site-&-bldg-permits-1)
         (activation-of ?a clear-site-&-bldg-permits)))

(forall ?a
  (=>(activation-of ?a clear-site-&-bldg-permits -1)
      (exists ?p
       (=> (activation-of ?p decomposition 114 1)
            (subactivity-occurrence ?a ?p))))))

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(and (doc draw-up-space-programme-&-requirements-1
  “The occurrence of Draw Up Space Programme & Requirements in the Decomposition-114.1 schematic”)
  (and (forall ?a
    (=>(activation-of ?a draw-up-space-programme-&-requirements-1)
      (activation-of ?a draw-up-space-programme-&-requirements-1)))
    (forall ?a
      (=>(activation-of ?a draw-up-space-programme-&-requirements-1)
        (exists ?p
          (=> (activation-of ?p decomposition 114.1)
            (subactivity-occurrence ?a ?p)))))

(and (doc plan-schedule-&-mode-of-operation-1
  “The occurrence of Plan Schedule & Mode of Operation in the Decomposition-114.1”)
  (and (forall ?a
    (=>(activation-of ?a plan-schedule-&-mode-of-operation-1)
      (activation-of ?a plan-schedule-&-mode-of-operation-1)))
    (forall ?a
      (=>(activation-of ?a plan-schedule-&-mode-of-operation-1)
        (exists ?p
          (=> (activation-of ?p decomposition 114.1)
            (subactivity-occurrence ?a ?p)))))

(and (doc set-cost-objectives-1
  “The occurrence of Set Cost Objectives in the Decomposition-114.1 schematic”)
  (and (forall ?a
    (=>(activation-of ?a set-cost-objectives-1)
      (activation-of ?a set-cost-objectives-1)))
    (forall ?a
      (=>(activation-of ?a set-cost-objectives-1)
        (exists ?p
          (=> (activation-of ?p decomposition 114.1)
            (subactivity-occurrence ?a ?p)))))

(and (doc prepare-investment-decision-1
  “The occurrence of Prepare Investment Decision in the Decomposition-114.1 schematic”)
  (and (forall ?a
    (=>(activation-of ?a prepare-investment-decision-1)
      (activation-of ?a prepare-investment-decision-1)))
    (forall ?a
      (=>(activation-of ?a prepare-investment-decision-1)
        (exists ?p
          (=> (activation-of ?p decomposition 114.1)
            (subactivity-occurrence ?a ?p)))))

(and (doc j1 “J1”)
  (and (forall ?j
    (=>(activation-of ?j j1)
      (exists ?p
        (=>(activation-of ?p decomposition 114.1)
          (subactivity-occurrence ?j ?p)))))

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(and (and_split j1 decomposition 114.1)
  (and (subactivity define-requirements j1)
    (and (subactivity clear-site-&-bldg-permits j1))))

(and (doc j2 "J2")
  (and (forall ?j
    (=>(activation-of ?j j2)
      (exists ?p
        (=>(activation-of ?p decomposition 114.1)
          (subactivity-occurrence ?j ?p))))))
  (and (follows j2 sect-cost-objects decomposition 114.1)
    (and (and_split j2 decomposition 114.1)
      (and (subactivity draw-up-space-programme-&-requirements j2)
        (and (subactivity plan-schedule-&-mode-of-operation j2))))))

(and (doc decomposition-115.1 "Decomposition of Make Overall Design")
  (and (subactivity start-building-design-1 decomposition-115.1)
    (and (subactivity design-basic-mass-alternatives-1 decomposition-115.1)
      (and (subactivity propose-solution-1 decomposition-115.1)
        (and (subactivity design-scheme-1 decomposition-115.1)
          (and (subactivity j1 decomposition-115.1)
            (iddef-process decomposition-115.1))))))

(and (doc start-building-design-1
  "The occurrence of Start-Building-Design in the Dec-115.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a start-building-design -1)
      (activation-of ?a start-building-design)))
    (and (forall ?a
      (=>(activation-of ?a start-building-design -1)
        ( exists ?p
          (=> (activation-of ?p decomposition 115.1)
            (subactivity-occurrence ?a ?p))))))
    (forall ?a
      (=>(activation-of ?a start-building-design -1)
        (activation-of ?a decomposition129.1))))))

(and (doc design-basic-mass-alternatives -1
  "The occurrence of Design Basic Mass Alternatives in the Dec-115.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a design-basic-mass-alternatives -1)
      (activation-of ?a design-basic-mass-alternatives)))
    (and (forall ?a
      (=>(activation-of ?a design-basic-mass-alternatives -1)
        ( exists ?p
          (=> (activation-of ?p decomposition 115.1)
            (subactivity-occurrence ?a ?p))))))
    (forall ?a
      (=>(activation-of ?a design-basic-mass-alternatives -1)
        (activation-of ?a decomposition130.1))))))
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(and (doc propose-solution-1
  "The occurrence of Propose Solution in the Dec-115 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a propose-solution -1)
      (activation-of ?a propose-solution)))
    (and (forall ?a
      (=>(activation-of ?a propose-solution -1)
        (exists ?p
          (=> (activation-of ?p decomposition 115 I)
            (subactivity-occurrence ?a ?p)))))))

(forall ?a
  (=>(activation-of ?a propose solution -1)
    (activation-of ?a decomposition131.1))))

(and (doc design-scheme-1
  "The occurrence of Design Scheme in the Dec-115.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a design-scheme -1)
      (activation-of ?a design-scheme)))
    (and (forall ?a
      (=>(activation-of ?a design-scheme -1)
        (exists ?p
          (=> (activation-of ?p decomposition 115 I)
            (subactivity-occurrence ?a ?p)))))))

(forall ?a
  (=>(activation-of ?a design scheme -1)
    (activation-of ?a decomposition132 1)))))

(and (doc decomposition-129 I "Decomposition of Start Building Design")
  (and (subactivity check-design-responsibilities-1 decomposition-129.1)
    (and (subactivity check-input-I decomposition-129.1)
      (and (subactivity plan-design-schedule-1 decomposition-129 1)
        (and (subactivity specify-special-requirements-&-needs-1 decomposition-129 1)
          (and (subactivity check-design-objectives-1 decomposition-129 1)
            (and (subactivity start-design-work-1 decomposition-129 1)
              (and (subactivity j1 decomposition-129.1)
                (and (subactivity j2 decomposition-129 1)
                  (idef-process decomposition-129.1))))))))

(and (doc check-design-responsibilities-1
  "The occurrence of Check Design Responsibilities in the Dec-129 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a check-design-responsibilities -1)
      (activation-of ?a check-design-responsibilities)))
    (forall ?a
      (=>(activation-of ?a check-design-responsibilities -1)
        (exists ?p
          (=> (activation-of ?p decomposition 129 I)
            (subactivity-occurrence ?a ?p))))))))
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(and (doc check-input -1
  "The occurrence of Check Input in the Dec-129 1 schematic")
  (and (forall ?a
          (=>(activation-of ?a check-input -1)
              (activation-of ?a check-input)))
          (forall ?a
              (=>(activation-of ?a check-input -1)
                  (exists ?p
                       (=> (activation-of ?p decomposition 129 1)
                            (subactivity-occurrence ?a ?p))))))

(and (doc plan-design-schedule -1
  "The occurrence of Plan-Design-Schedule in the Dec-129 1 schematic")
  (and (forall ?a
          (=>(activation-of ?a plan-design-schedule -1)
              (activation-of ?a plan-design-schedule)))
          (forall ?a
              (=>(activation-of ?a plan-design-schedule -1)
                  (exists ?p
                       (=> (activation-of ?p decomposition 129 1)
                            (subactivity-occurrence ?a ?p))))))

(and (doc specify-special-requirements-&-needs-1
  "The occurrence of Specify Special Requirements & Needs in the Dec-129 1 schematic")
  (and (forall ?a
          (=>(activation-of ?a specify-special-requirements-&-needs-1)
              (activation-of ?a specify-special-requirements-&-needs)))
          (forall ?a
              (=>(activation-of ?a specify-special-requirements-&-needs-1)
                  (exists ?p
                       (=> (activation-of ?p decomposition 129 1)
                            (subactivity-occurrence ?a ?p))))))

(and (doc check-design-objectives-1
  "The occurrence of Check Design Objectives in the Dec-129 1 schematic")
  (and (forall ?a
          (=>(activation-of ?a check-design-objectives -1)
              (activation-of ?a check-design-objectives)))
          (forall ?a
              (=>(activation-of ?a check-design-objectives -1)
                  (exists ?p
                       (=> (activation-of ?p decomposition 129 1)
                            (subactivity-occurrence ?a ?p))))))

(and (doc start-design-work -1
  "The occurrence of Start Design Work in the Dec-129.1 schematic")
  (and (forall ?a
          (=>(activation-of ?a start-design-work -1)
              (activation-of ?a start-design-work)))

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(forall ?a
  (=>(activation-of ?a start-design-work -I)
  (exists ?p
    (=> (activation-of ?p decomposition 129 1)
      (subactivity-occurrence ?a ?p))))))

(and (doc j1 "J1")
  (and (forall ?j
    (=>(activation-of ?j j1)
    (exists ?p
      (=>(activation-of ?p decomposition 129 1)
        (subactivity-occurrence ?j ?p))))))
    (and (and_split j1 decomposition 129 1)
      (and (subactivity check-design-responsibilities j1)
        (and (subactivity check-input j1))))))

(and (doc j2 "J2")
  (and (forall ?j
    (=>(activation-of ?j j2)
    (exists ?p
      (=>(activation-of ?p decomposition 129 1)
        (subactivity-occurrence ?j ?p))))))
    (and (follows j2 specify-special-requirements-&-needs 129 1)
      (and (and_split j2 decomposition 129 1)
        (and (subactivity plan-design schedule j2)
          (and (subactivity check-input j2))))))

(and (doc decomposition-130 1 "Decomposition of Design Basic Mass Alternatives")
  (and (subactivity design-site-usage-alternatives-1 decomposition-130 1)
    (and (subactivity design-basic-mass-Alternatives-1 decomposition-130 1)
      (and (subactivity estimate-scope-efficiency-cost-1 decomposition-130 1)
        (and (subactivity analyse-environmental-effects-1 decomposition-130 1)
          (and (subactivity present-solutions-to-client-1 decomposition-130 1)
            (idef-process decomposition-130 1))))))

(and (doc design-site-usage-alternatives-1
  "The occurrence of Design Site Usage Alternatives in the Dec-130 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a design-site-usage-alternatives-1)
      (activation-of ?a design-site-usage-alternatives)))
    (forall ?a
      (=>(activation-of ?a design-site-usage-alternatives-1)
        (activation-of ?a design-site-usage-alternatives)))
    (forall ?a
      (=>(activation-of ?a design-site-usage-alternatives-1)
        (exists ?p
          (=> (activation-of ?p decomposition 130.1)
            (subactivity-occurrence ?a ?p))))))

(and (doc design-basic-mass-Alternatives-1
  "The occurrence of Design Basic Mass Alternatives in the Dec-130 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a design-basic-mass-Alternatives-1)
      (activation-of ?a design-basic-mass-Alternatives)))
    (forall ?a
      (=>(activation-of ?a design-basic-mass-Alternatives-1)
        (activation-of ?a design-basic-mass-Alternatives-1)))
    (forall ?a
      (=>(activation-of ?a design-basic-mass-Alternatives-1)
        (exists ?p
          (=> (activation-of ?p decomposition 130.1)
            (subactivity-occurrence ?a ?p))))))
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(forall ?a
 (=>(activation-of ?a design-basic-mass-alternatives-1)
 (exists ?p
 (=> (activation-of ?p decomposition 130 1)
 (subactivity-occurrence ?a ?p))))))

(and (doc estimate-scope-efficiency-cost-1
 "The occurrence of Estimate Scope, Efficiency & Cost in the Dec-130 1 schematic")
 (forall ?a
 (=>(activation-of ?a estimate-scope-efficiency-cost-1)
 (activation-of ?a estimate-scope-efficiency-cost))

(forall ?a
 (=>(activation-of ?a estimate-scope-efficiency-cost-1)
 (exists ?p
 (=> (activation-of ?p decomposition 130 1)
 (subactivity-occurrence ?a ?p))))))

(and (doc analyse-environmental-effects-1
 "The occurrence of Analyse Environmental Effects in the Dec-130 1 schematic")
 (forall ?a
 (=>(activation-of ?a analyse-environmental-effects -1)
 (activation-of ?a analyse-environmental-effects))

(forall ?a
 (=>(activation-of ?a analyse-environmental-effects-1)
 (exists ?p
 (=> (activation-of ?p decomposition 130 1)
 (subactivity-occurrence ?a ?p))))))

(and (doc present-solutions-to-client-1
 "The occurrence of Present Solutions to Client in the Dec-130 1 schematic")
 (forall ?a
 (=>(activation-of ?a present-solutions-to-client-1)
 (activation-of ?a present-solutions-to-client))

(forall ?a
 (=>(activation-of ?a present-solutions-to-client-1)
 (exists ?p
 (=> (activation-of ?p decomposition 130 1)
 (subactivity-occurrence ?a ?p))))))

(and (doc decomposition-131 1 "Decomposition of Start Building Design")
 (exists \path{tactvty decompostlOn-131.1}
 (subactivity check-input-documents-1 decomposition-131.1)
 (and (subactivity make-preliminary-layout-drawings-1 decomposition-131.1)
 (subactivity define-architectural-&-technical-solutions-1 decomposition-131.1)
 (subactivity assemble-information-of-proposed-solution-1 decomposition-131.1)
 (subactivity prepare-application-of-permits-1 decomposition-131.1)
 (subactivity present-solution-for-approval-&-co-ordinate-design
 (subactivity assemble-information-of-proposed-solution-1 decomposition-131.1)
 (subactivity define-architectural-&-technical-solutions-1 decomposition-131.1)
 (subactivity make-preliminary-layout-drawings-1 decomposition-131.1)
 (subactivity check-input-documents-1 decomposition-131.1)
 (subactivity decomposttlOn-131.1)
 (tdef-process decompostlOn-131.1))))))))))))

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(and (doc check-input-documents-1
"The occurrence of Check Input Documents in the Dec-131 schematic")
(and (forall ?a
(=>(activation-of ?a check-input-documents-1)
(activation-of ?a check-input-documents)))

(forall ?a
(=>(activation-of ?a check-input-documents-1)
(exists ?p
(=> (activation-of ?p decomposition 131.1)
(subactivity-occurrence ?a ?p))))))

(and (doc make-preliminary-layout-drawings-1
"The occurrence of Make Preliminary Layout Drawings in the Dec-131 schematic")
(and (forall ?a
(=>(activation-of ?a make-preliminary-layout-drawings-1)
(activation-of ?a make-preliminary-layout-drawings)))

(forall ?a
(=>(activation-of ?a make-preliminary-layout-drawings-1)
(exists ?p
(=> (activation-of ?p decomposition 131.1)
(subactivity-occurrence ?a ?p))))))

(and (doc define-architectural-&-technical-solutions-1
"The occurrence of Define Architectural & Technical Solutions in the Dec-131 schematic")
(and (forall ?a
(=>(activation-of ?a define-architectural-&-technical-solutions-1)
(activation-of ?a define-architectural-&-technical-solutions)))

(forall ?a
(=>(activation-of ?a define-architectural-&-technical-solutions-1)
(exists ?p
(=> (activation-of ?p decomposition 131.1)
(subactivity-occurrence ?a ?p))))))

(and (doc assemble-information-of-proposed solution-1
"The occurrence of Assemble Information of Proposed Solution in the Dec-131 schematic")
(and (forall ?a
(=>(activation-of ?a assemble-information-of-proposed solution-1)
(activation-of ?a assemble-information-of-proposed solution)))

(forall ?a
(=>(activation-of ?a assemble-information-of-proposed solution-1)
(exists ?p
(=> (activation-of ?p decomposition 131.1)
(subactivity-occurrence ?a ?p))))))

(and (doc prepare-application-of-permits-1
"The occurrence of Prepare Application of Permits in the Dec-131 schematic")
(and (forall ?a
(=>(activation-of ?a prepare-application-of-permits-1)
(activation-of ?a prepare-application-of-permits)))

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(forall ?a
  (=>(activation-of ?a prepare-application-of-permits-1)
   (exists ?p
    (=> (activation-of ?p decomposition 131 1)
     (subactivity-occurrence ?a ?p))))))

(and (doc present-solution-for-approval-&-coordinate-design-work-1
  "The occurrence of Present Solution for Approval & Co-ordinate Design work in the Dec-131 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a present-solution-for-approval-&-coordinate-design-work-1)
     (activation-of ?a present-solution-for-approval-&-coordinate-design-work-1)))
    (forall ?a
     (=>(activation-of ?a present-solution-for-approval-&-coordinate-design-work-1)
      (exists ?p
        (=> (activation-of ?p decomposition 131 1)
         (subactivity-occurrence ?a ?p))))))

(and (doc j1 "J1")
  (and (forall ?j
    (=>(activation-of ?j j1)
     (exists ?p
      (=>(activation-of ?p decomposition 131 1)
       (subactivity-occurrence ?j ?p))))
      (and (and_split j1 decomposition 131 1)
       (and (subactivity make-preliminary-layout-drawings j2)
        (and (subactivity define-architectural-&-technical-solution j2))))))

(and (doc j2 "J2")
  (and (forall ?j
    (=>(activation-of ?j j2)
     (exists ?p
      (=>(activation-of ?p decomposition 131 1)
       (subactivity-occurrence ?j ?p))))
      (and (follows j2 assemble-information-of-proposed-solution decomposition 131 1)
       (and (and_split j2 decomposition 131 1)
        (and (subactivity make-preliminary-layout-drawings j2)
         (and (subactivity define-architectural-&-technical-solution j2))))))

(and (doc decomposition-131 1 "Decomposition of Design Schemes")
  (and (subactivity estimate-feed-back-make-layout-dwgs-&-Environmental-plan decomposition-132 1)
    (and (subactivity make-scheme-design decomposition-132 1)
      (and (subactivity check-technical-systems-&-design-compatibility decomposition-132 1)
        (and (subactivity prepare-general-description decomposition-132 1)
          (and (subactivity do-task-concerning-building-permits decomposition-132 1)
            (and (subactivity make-decision-concerning-further-design decomposition-132 1)
              (and (subactivity j1 decomposition-132 1)
               (idef-process decomposition-132 1)))))

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(and (doc estimate-feedback-make-layout-dwgs-&-Environmental-plan-1
  "The occurrence of Estimate-Feed-Back-Make-Layout-Dwgs-&-Environmental-Plan in the Dec-132 schematic")
  (and (forall ?a
    (=> (activation-of ?a estimate-feedback-make-layout-dwgs-&-Environmental-plan-1)
        (activation-of ?a estimate-feedback-make-layout-dwgs-&-Environmental-plan-1))))

  (forall ?a
    (=> (activation-of ?a estimate-feedback-make-layout-dwgs-&-Environmental-plan-1)
        (exists ?p
         (=> (activation-of ?p decomposition 132.1)
             (subactivity-occurrence ?a ?p))))))

(and (doc make-scheme-design-1
  "The occurrence of Make Scheme Design in the Dec-132 schematic")
  (and (forall ?a
    (=> (activation-of ?a make-scheme-design-1)
        (activation-of ?a make-scheme-design-1))
    (and (forall ?a
      (=> (activation-of ?a make-scheme-design-1)
          (exists ?p
           (=> (activation-of ?p decomposition 132.1)
               (subactivity-occurrence ?a ?p))))
      (forall ?a
        (=> (activation-of ?a make-scheme-design-1)
            (activation-of ?a decomposition 151.1))))
  (forall ?a
    (=> (activation-of ?a make-scheme-design-1)
        (exists ?01
         (exists ?02
          (exists ?03
           (exists ?04
            (=> (and (instance-of ?01 general-layout-DWG)
                     (instance-of ?02 environmental-plan)
                     (instance-of ?03 proposed-solution-feed-back brief)
                     (instance-of ?04 general-design))
                (exists ?01)
                (input-data ?02 ?a)
                (controls ?03 ?a)
                (output-data ?04 ?a))))))))

(and (doc check-technical-systems-&-design-compatibility-1
  "The occurrence of Check Technical Systems & Design Compatibility in the Dec-132 schematic")
  (and (forall ?a
    (=> (activation-of ?a check-technical-systems-&-design-compatibility-1)
        (activation-of ?a check-technical-systems-&-design-compatibility-1))
    (forall ?a
      (=> (activation-of ?a check-technical-systems-&-design-compatibility-1)
          (exists ?p
           (=> (activation-of ?p decomposition 132.1)
               (subactivity-occurrence ?a ?p))))))

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(and (doc prepare-general-description-1
  "The occurrence of Prepare General Description in the Dec-132.1 schematic")
  (and (forall ?a
        (=>(activation-of ?a prepare-general-description-1)
            (activation-of ?a prepare-general-description)))

  (forall ?a
    (=>(activation-of ?a prepare-general-description-1)
        (exists ?p
          (=> (activation-of ?p decomposition 132 1)
               (subactivity-occurrence ?a ?p)))))))

(and (doc do-tasks-concerning-building-permits-1
  "The occurrence of Do Tasks Concerning Building Permits in the Dec-132.1 schematic")
  (and (forall ?a
        (=>(activation-of ?a do-tasks-concerning-building-permits-1)
            (activation-of ?a do-tasks-concerning-building-permits)))

  (forall ?a
    (=>(activation-of ?a do-tasks-concerning-building-permits-1)
        (exists ?p
          (=> (activation-of ?p decomposition 132 1)
               (subactivity-occurrence ?a ?p)))))))

(and (doc make-decision-concerning-further-design-1
  "The occurrence of Make Decision Concerning Further Design-in the Dec-132.1 schematic")
  (and (forall ?a
        (=>(activation-of ?a make-decision-concerning-further-design-1)
            (activation-of ?a make-decision-concerning-further-design)))

  (forall ?a
    (=>(activation-of ?a make-decision-concerning-further-design-1)
        (exists ?p
          (=> (activation-of ?p decomposition 132 1)
               (subactivity-occurrence ?a ?p)))))))

(and (doc "J1"
  (and (forall ?j
        (=>(activation-of ?j J1)
            (exists ?p
              (=>(activation-of ?p decomposition 132 1)
                  (subactivity-occurrence ?j ?p))))))

  (and (follows prepare-general-description J1 decomposition 132.1)
       (and (and_split J1 decomposition 132 1)
            (and (subactivity make-decision-concerning-building-permit J2)
                 (and (subactivity do-tasks-concerning-building-permit J2)))))))))

(and (doc decomposition-151.1 "Decomposition of Make Scheme Design")
  (and (subactivity make-general-space-design-1 decomposition-151.1)
       (and (subactivity make-general-façade-design-1 decomposition-151.1)
            (and (subactivity make-general-design-of-repetitive-units-1 decomposition-151.1)
                 (and (subactivity make-general-design-of fittings-151.1)
                      (and (subactivity make-general-design-essential-sections-1 decomposition-151.1)
                           (and (subactivity make-general-layout-drawing-1 decomposition-151.1)
                                (idef-process decomposition-151.1)))))))))

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(and (doc make-general-space-design-I
   "The occurrence of Make general Space Design in the Dec-151 1 schematic")
   (and (forall ?a
      (=>(activation-of ?a make-general-space-design-I)
         (activation-of ?a make-general-space-design)))
   (and (forall ?a
      (=>(activation-of ?a make-general-space-design-I)
         (exists ?p
         (=>(activation-of ?p decomposition 151.1)
            (subactivity-occurrence ?a ?p)))))
   (forall ?a
      (=>(activation-of ?a make-general-space-design-I)
         (activation-of ?a decomposition156.1))))))

(forall ?a
   (=>(activation-of ?a make-general-space-design-I)
      (exists ?01
      (exists ?02
      (exists ?03
         (=> (and (Instance-of ?01 space-programme-building-requirement)
            (Instance-of ?02 building-requirement)
            (Instance-of ?03 general-space-design))
            (input-data ?01 ?a)
            (controls ?02 ?a)
            (output-data ?03 ?a)))))))

(and (doc make-general-fa9ade-deslgn-1
   "The occurrence of Make General Façade Design & Elevations in the Dec-151 1 schematic")
   (and (forall ?a
      (=>(activation-of ?a make-general-fa9ade-deslgn-1)
         (activation-of ?a make-general-fa9ade-design)))
   (and (forall ?a
      (=>(activation-of ?a make-general-fa9ade-deslgn-1)
         (exists ?01
      (exists ?02
      (exists ?03
         (=> (and (Instance-of ?01 space-programme-building-requirement)
            (Instance-of ?02 feedback-briefing-of-proposed-solution)
            (Instance-of ?03 general-fa9ade-design))
            (input-data ?01 ?a)
            (controls ?02 ?a)
            (output-data ?03 ?a)))))))

(forall ?a
   (=>(activation-of ?a make-general-fa9ade-deslgn-1)
      (activation-of ?a decomposition157.1))))))

(forall ?a
   (=>(activation-of ?a make-general-fa9ade-deslgn-1)
      (exists ?01
      (exists ?02
      (exists ?03
         (=> (and (Instance-of ?01 space-layout-drawings)
            (Instance-of ?02 feedback-briefing-of-proposed-solution)
            (Instance-of ?03 general-fa9ade-design))
            (input-data ?01 ?a)
            (controls ?02 ?a)
            (output-data ?03 ?a))))))

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(and (doc make-general-design-of-repetitive-units-1
          "The occurrence of Make general Design of Repetitive Units in the Dec-151 1 schematic")
  (and (forall ?a
            (=>(activation-of ?a make-general-design-of-repetitive-units-1)
                (activation-of ?a make-general-design-of-repetitive-units-1)))
            (forall ?a
                (=>(activation-of ?a make-general-design-of-repetitive-units-1)
                    (exists ?p
                        (=> (activation-of ?p decomposition 151 1)
                            (subactivity-occurrence ?a ?p)))))))

(and (doc make-general-design-of-fittings-1
          "The occurrence of Make General Design of Fittings in the Dec-151.1 schematic")
  (and (forall ?a
            (=>(activation-of ?a make-general-design-of-fittings-1)
                (activation-of ?a make-general-design-of-fittings-1)))
            (forall ?a
                (=>(activation-of ?a make-general-design-of-fittings-1)
                    (exists ?p
                        (=> (activation-of ?p decomposition 151 1)
                            (subactivity-occurrence ?a ?p)))))))

(and (doc make-general-design-essential-sections-1
          "The occurrence of Make General Design Essential Sections in the Dec-151 1")
  (and (forall ?a
            (=>(activation-of ?a make-general-design-essential-sections-1)
                (activation-of ?a make-general-design-essential-sections-1)))
            (forall ?a
                (=>(activation-of ?a make-general-design-essential-sections-1)
                    (exists ?p
                        (=> (activation-of ?p decomposition 151 1)
                            (subactivity-occurrence ?a ?p)))))))

(and (doc make-general-layout-drawing-1
          "The occurrence of Make General Layout Drawing Sections in the Dec-151 1 schematic")
  (and (forall ?a
            (=>(activation-of ?a make-general-layout-drawing-1)
                (activation-of ?a make-general-layout-drawing-1)))
            (forall ?a
                (=>(activation-of ?a make-general-layout-drawing-1)
                    (exists ?p
                        (=> (activation-of ?p decomposition 151 1)
                            (subactivity-occurrence ?a ?p)))))))

(and (doc decomposition-156-1 "Decomposition of Make Scheme Design")
  (and (subactivity make-preliminary-main-space-layout-1 decomposition-156.1)
       (and (subactivity design-core-spaces-1 decomposition-156 1)
            (and (subactivity determine-circulation-spaces-1 decomposition-156.1)
                 (and (subactivity design-spaces-for-fire-compartment-156 1)
                      (idef-process decomposition-156 1))))))

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(and (doc define-make-preliminary-space-layout-for-main-us -1
  "The occurrence of Define Make Preliminary Layout of Main Space in the Dec-156 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a define-make-preliminary-space-layout-for-main-us-1)
      (activation-of ?a define-make-preliminary-space-layout-for-main-us)))
  (and (forall ?a
    (=>(activation-of ?a define-make-preliminary-space-layout-for-main-us-1)
      (exists ?p
        (=> (activation-of ?p decomposition 156 1)
          (subactivity-occurrence ?a ?p))))))

(forall ?a
  (=>(activation-of ?a define-make-preliminary-space-layout-for-main-us -1)
      (activation-of ?a decomposition162.1)))

(forall ?a
  (=>(activation-of ?a design-core-spaces-1)
      (activation-of ?a design-core-spaces)))

(forall ?a
  (=>(activation-of ?a design-core-spaces-1)
      (exists ?01
        (exists ?02
          (exists ?03
            (=> (and (instance-of ?01 space-programme)
              (instance-of ?02 building-requirement)
              (instance-of ?03 general-space-for-main-use))
            (and (input-data ?01 ?a)
              (controls ?02 ?a)
              (out-put data ?03 ?a))))))))

(and (doc design-core-spaces-1
  "The occurrence of Design Core Spaces in the Dec-156 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a design-core-spaces-1)
      (activation-of ?a design-core-spaces)))
  (and (forall ?a
    (=>(activation-of ?a design-core-spaces-1)
      (exists ?p
        (=> (activation-of ?p decomposition 156 1)
          (subactivity-occurrence ?a ?p))))))

(forall ?a
  (=>(activation-of ?a design core spaces -1)
      (activation-of ?a decomposition163 1))))

(and (doc determine-circulation-spaces-1
  "The occurrence of Determine Circulation Spaces in the Dec-156 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a determine-circulation-spaces-1)
      (activation-of ?a determine-circulation-spaces)))
  (forall ?a
    (=>(activation-of ?a determine-circulation-spaces-1)
      (exists ?p
        (=> (activation-of ?p decomposition 156 1)
          (subactivity-occurrence ?a ?p))))))

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(=> (and (attribute-shape 204 203)
  (attribute-dimension 205 203)
  (attribute-location 206 203)
  (attribute-count-of-space 207 203))))))))

(and (doc define-floor-1
  "The occurrence of Define Floor in the Dec-162.1 schematic")
  (forall ?a
    (=> (activation-of ?a define-floor-1)
      (activation-of ?a define-floor)))

(foreall ?a
  (=> (activation-of ?a define-floor-1)
    (exists ?p
     (=> (activation-of ?p decomposition 162 1)
       (subactivity-occurrence ?a ?p)))))

(foreall ?a
  (=> (activation-of ?a define-floor-1)
    (exists 201
     (exists 202
      (exists 203
       (=> (and (instance-of 201 generated-space)
                  (instance-of 202 building-programme-requirement)
                  (instance-of 203 defined-floor))
        (and (input-data 201 ?a)
          (controls 202 ?a)
          (output-data 203 ?a))))))))

(and (doc organise-space-into-floor-1
  "The occurrence of Organise Space into Floor in the Dec-162.1 schematic")
  (forall ?a
    (=> (activation-of ?a organise-space-into-floor-1)
      (activation-of ?a organise-space-into-floor)))

(foreall ?a
  (=> (activation-of ?a organise-space-into-floor-1)
    (exists ?p
     (=> (activation-of ?p decomposition 162 1)
       (subactivity-occurrence ?a ?p))))))

(foreall ?a
  (=> (activation-of ?a organise-space-into-floor-1)
    (exists 201
     (exists 202
      (exists 203
       (=> (and (instance-of 201 space-generated)
                  (instance-of 202 building-programme-requirement/structural-grid/shell/core-position)
                  (instance-of 203 organised-spaces))
        (and (input-data 201 ?a)
          (controls 202 ?a)
          (output-data 203 ?a))))))))
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(and (doc determine-main-space-depth-&-circulation-paths-1
  "The occurrence of Determine Main Space Depth & Circulation Spaces in the Dec-162.1 schematic")
  (forall ?a
    (=>(activation-of ?a determine-main-space-depth-&-circulation-paths-1)
      (activation-of ?a determine-main-space-depth-&-circulation-paths-1)))
  (forall ?a
    (=>(activation-of ?a determine-main-space-depth-&-circulation-paths-1)
      (exists ?p
       (=> (activation-of ?p decomposition 162.1)
          (subactivity-occurrence ?a ?p))))))

(and (doc check-spaces-against-programme-1
  "The occurrence of Check Spaces Against Programme in the Dec-162.1 schematic")
  (forall ?a
    (=>(activation-of ?a check-spaces-against-programme-1)
      (activation-of ?a check-spaces-against-programme-1)))
  (forall ?a
    (=>(activation-of ?a check-spaces-against-programme-1)
      (exists ?p
       (=> (activation-of ?p decomposition 162.1)
          (subactivity-occurrence ?a ?p))))))

(and (doc decomposition-163 1 "Design Core Sapces")
  (and (subactivity determine core space requirements -1 decomposition-163 1)
    (and (subactivity determine core spaces' shape and size-1 decomposition 163 1)
      (and (subactivity layout core spaces-1 decomposition-163 1)
        (idef-process decomposition-163.1))))
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(and (doc determine-core-space-requirements-1
   "The occurrence of Determine Core Space Requirements in the Dec-1631 schematic")
   (and (forall ?a
         (=>(activation-of ?a determine-core-space-requirements-1)
             (activation-of ?a determine-core-space-requirements)))))

(forall ?a
  (=>(activation-of ?a determine-core-space-requirements-1)
      (exists ?p
       (=> (activation-of ?p decomposition 1631)
            (subactivity-occurrence ?a ?p))))))

(and (doc determine-shape-size-of-core-spaces-1 "The occurrence of Determine Shape Size of Core Spaces in the Dec-1631 schematic")
   (and (forall ?a
         (=>(activation-of ?a determine-shape-size-of-core-spaces-1)
             (activation-of ?a determine-shape-size-of-core-spaces)))))

(forall ?a
  (=>(activation-of ?a determine-shape-size-of-core-spaces-1)
      (exists ?p
       (=> (activation-of ?p decomposition 1631)
            (subactivity-occurrence ?a ?p))))))

(and (doc layout-core-spaces-1
   "The occurrence of Determine Layout Core Spaces in the Dec-1631 schematic")
   (and (forall ?a
         (=>(activation-of ?a layout-core-spaces-1)
             (activation-of ?a layout-core-spaces)))))

(forall ?a
  (=>(activation-of ?a layout-core-spaces-1)
      (exists ?p
       (=> (activation-of ?p decomposition 1631)
            (subactivity-occurrence ?a ?p))))))

(and (doc decompostlOn-165.1 "determine spaces for fire compartment")
   (and (subactivity identify-main-ancilla! use-spaces-1 decomposition-165 1)
        (and (subactivity check-ancilla! use-spaces-for-main-use-1 decomposition 165 1)
             (and (subactivity identify-single-occupancy-spaces-1 decomposition-165.1)
                  (and (subactivity identify-area-voume-of-spaces-1 decomposition-165 1)
                       (and (subactivity specify-boundaries-as-fine-compartment-boundaries-1 decomposition-165 1)
                            (def-process decompostlOn-165 1)))))))

(and (doc identify-main-ancilla! use-spaces-1
   "The occurrence of Identify Main/Ancillary Use Spaces in the Dec-165.1 schematic")
   (and (forall ?a
         (=>(activation-of ?a identify-main-ancilla! use-spaces-1)
             (activation-of ?a identify-main-ancilla! use-spaces)))))

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(forall ?a
  (=> (activation-of ?a identify-main-ancillary-use-spaces-1)
      (exists ?p
       (=> (activation-of ?p decomposition 165.1)
            (subactivity-occurrence ?a ?p))))))

(and (doc check-ancillary-use-spaces-for-main-use-1
      "The occurrence of Check Ancillary Use Spaces for Main Use in the Dec-165 1 schematic")
     (forall ?a
      (=> (activation-of ?a check-ancillary-use-spaces-for-main-use-1)
           (activation-of ?a check-ancillary-use-spaces-for-main-use))))

(forall ?a
  (=> (activation-of ?a check-ancillary-use-spaces-for-main-use-1)
       (exists ?p
        (=> (activation-of ?p decomposition 165.1)
             (subactivity-occurrence ?a ?p))))))

(and (doc identify-single-occupancy-spaces-1
      "The occurrence of Identify Single Occupancy Spaces in the Dec-165 1 schematic")
     (forall ?a
      (=> (activation-of ?a identify-single-occupancy-spaces-1)
           (activation-of ?a identify-single-occupancy-spaces)))

(forall ?a
  (=> (activation-of ?a identify-single-occupancy-spaces-1)
       (exists ?p
        (=> (activation-of ?p decomposition 165.1)
             (subactivity-occurrence ?a ?p))))))

(and (doc identify-area-volume-of-spaces-1
      "The occurrence of Identify Area/Volume of Spaces in the Dec-165 1 schematic")
     (forall ?a
      (=> (activation-of ?a identify-area-volume-of-spaces-1)
           (activation-of ?a identify-area-volume-of-spaces)))

(forall ?a
  (=> (activation-of ?a identify-area-volume-of-spaces-1)
       (exists ?p
        (=> (activation-of ?p decomposition 165.1)
             (subactivity-occurrence ?a ?p))))))

(and (doc specify-space-boundaries-as-fine-compartment-boundaries-1
      "The Occurrence of Specify Space Boundaries as Fire Compartment Boundaries in the Dec-156 1 schematic")
     (forall ?a
      (=> (activation-of ?a specify-space-boundaries-as-fine-compartment-boundaries-1)
           (activation-of ?a specify-space-boundaries-as-fine-compartment-boundaries)))

(forall ?a
  (=> (activation-of ?a specify-space-boundaries-as-fine-compartment-boundaries-1)
       (exists ?p
        (=> (activation-of ?p decomposition 156.1)
             (subactivity-occurrence ?a ?p))))))
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(forall ?a
(=>(activation-of ?a specify-space-boundaries-as-fine-compartment-boundaries-1)
(activation-of ?a decomposition178 1))))

(and (doc decomposition-178 1 "Specify Space Boundaries as Fire Compartment Boundaries")
 (and (subactivity analyse-fire-compartments-defined-by-single-use-occupancy-1 decomposition-178 1)
 (and (subactivity check-regulation-for-maximum-fire-use-dimensions-1 decomposition 178 1)
 (and (subactivity subdivide-each-fire-compartment-to-meet-constraints-1 decomposition-178 1)
 (idef-process decomposition-178.1)))

(and (doc analyse-fire-compartments-defined-by-single-use-occupancy-1
 "The occurrence of Analyse Fire Compartments Defined by Single Use Occupancy in the Dec-178 schematic")
 (and (forall ?a
 (=>(activation-of ?a analyse-fire-compartments-defined-by-single-use-occupancy-1)
 (activation-of ?a analyse-fire-compartments-defined-by-single-use-occupancy-1)))

(forrall ?a
(=>(activation-of ?a analyse-fire-compartments-defined-by-single-use-occupancy-1)
(exists ?p
(=> (activation-of ?p decomposition 178.1)
(subactivity-occurrence ?a ?p))))))

(and (doc check-regulation-for-maximum-fire-use-dimensions-1 "The occurrence of Check Regulation For Maximum Fire Use Dimensions in the Dec-178 1")
 (and (forall ?a
 (=>(activation-of ?a check-regulation-for-maximum-fire-use-dimensions-1)
 (activation-of ?a check-regulation-for-maximum-fire-use-dimensions-1)))

(forrall ?a
(=>(activation-of ?a check-regulation-for-maximum-fire-use-dimensions-1)
(exists ?p
(=> (activation-of ?p decomposition 178.1)
(subactivity-occurrence ?a ?p))))))

(and (doc subdivide-each-fire-compartment-to-meet-constraints-1
 "The occurrence of Subdivide Each Fire Compartment To Meet Constraints in the Dec-178 1 schematic")
 (and (forall ?a
 (=>(activation-of ?a subdivide-each-fire-compartment-to-meet-constraints-1)
 (activation-of ?a subdivide-each-fire-compartment-to-meet-constraints-1)))

(forrall ?a
(=>(activation-of ?a subdivide-each-fire-compartment-to-meet-constraints-1)
(exists ?p
(=> (activation-of ?p decomposition 178 1)
(subactivity-occurrence ?a ?p))))))
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(and (doc decomposition-157.1 "Make General Façade Design")
  (and (subactivity determine-bldg-mass-1 decomposition-157 1)
    (and (subactivity determine-façade-structure-relationship-1 decomposition 157 1)
      (and (subactivity determine-fenestration-1 decomposition-157 1)
        (and (subactivity determine-façade-material-1 decomposition-157 1)
          (and (subactivity make-design-of-adornments-of-façade-1 Decomposition-157 1)
            (def-process decomposition-157 1)))))))))

(and (doc determine-building-mass-1 “The occurrence of Determine Building Mass in the Dec-157 1 schematic”)
  (and (forall ?a
    (=>(activation-of ?a determine-building-mass-1)
      (activation-of ?a determine-building-mass)))
    (forall ?a
      (=>(activation-of ?a determine-building-mass-1)
        (exists ?p
          (=> (activation-of ?p decomposition 157 1)
            (subactivity-occurrence ?a ?p))))

    (forall ?a
      (=>(activation-of ?a determine-building-mass-1)
        (exists ?01
          (exists ?02
            (exists ?03
              (=> (and (instance-of ?01 floor-space-plates-created)
                  (instance-of ?02 proposed-solution/feedback-brief)
                  (instance-of ?03 building-mass))
                (and (input-data ?01 ?a)
                  (controls ?02 ?a)
                  (output-data ?03 ?a))))))

    (forall ?03
      (=>(building-mass ?03)
        (exists ?04
          (exists ?05
            (=> (and (attribute-shape ?04 ?03)
                (attribute-dimension/volume/area ?05 ?03)))
              ))))

  (forall ?03
    (=>(building-mass ?03)
      (exists ?04
        (exists ?05
          (=> (and (attribute-shape ?04 ?03)
              (attribute-dimension/volume/area ?05 ?03)))
              )))

  (forall ?a
    (=>(activation-of ?a determine-façade-structure-relationship-1)
      (activation-of ?a determine-façade-structure-relationship)))

  (forall ?a
    (=>(activation-of ?a determine-façade-structure-relationship-1)
      (exists ?p
        (=> (activation-of ?p decomposition 157.1)
          (subactivity-occurrence ?a ?p))))))

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(forall ?a
  (=>(activation-of ?a determine-façade-structure-relationship-1)
      (exits ?01
       (exists ?02
        (exists ?03
         (=> (and (instance-of ?01 structural-design-brief)
                (instance-of ?02 architect’s-design-effects)
                (instance-of ?03 preliminary-structural-grid))
          (and (input-data ?01 ?a)
               (controls ?02 ?a)
               (out-put data ?03 ?a))))))
  (and (forall ?03
         (=>(preliminary-structural-grid ?03)
             (exists ?04
              (exists ?05
               (=> (and (attribute-shape ?04 ?03)
                        (attribute-dimensions ?05 ?03)))))))))

(and (doc determine-fenestration-1
      "The occurrence of Determine Fenestration in the Dec-157 1 schematic")
  (and (forall ?a
        (=>(activation-of ?a determine-fenestration-1)
            (activation-of ?a determine-fenestration))
        (forall ?a
         (=>(activation-of ?a determine-fenestration-1)
             (exists ?p
              (=> (activation-of ?p decomposition 157 1)
                   (subactivity-occurrence ?a ?p))))))
  (forall ?a
   (=>(activation-of ?a determine-fenestration-1)
       (exits ?01
        (exists ?02
         (exists ?03
          (=> (and (instance-of ?01 general-space-design/bldg-mass)
                 (instance-of ?02 site/building-face-orientation)
                 (instance-of ?03 fenestration))
           (and (input-data ?01 ?a)
                (controls ?02 ?a)
                (out-put data ?03 ?a))))))
  (and (forall ?03
         (=>(fenestration ?03)
             (exists ?04
              (exists ?05
               (exists ?06
                (=> (and (attribute-location ?04 ?03)
                         (attribute-shape ?05 ?03)
                         (attribute-dimensions/size ?06 ?03)))))))))

(and (doc determine-façade-material-1
      "The occurrence of Determine Façade Material in the Dec-157 1 schematic")
  (and (forall ?a
        (=>(activation-of ?a determine-façade-material-1)
            (activation-of ?a determine-façade-material))))
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(forall ?a
   (=>(activation-of ?a determine-façade-material -1)
       (exists ?p
           (=> (activation-of ?p decomposition 157.1)
            (subactivity-occurrence ?a ?p))))

(forall ?a
   (=>(activation-of ?a determine-façade-material-1)
       (exists ?01
           (exists ?02
               (exists ?03
                   (=> (instance-of ?01 proposed-solution/building-mass)
                        (instance-of ?02 regional-style-
                                    regional-construction-method)
                        (instance-of ?03 material-of-construction))
                    (input-data ?01 ?a)
                    (controls ?02 ?a)
                    (output-data ?03 ?a))))))

(and (forall ?03
       (=>(material-of-construction ?03)
           (exists ?04
               (exists ?05
                   (exists ?06
                       (=> (attribute-??? ?04 ?03)
                            (attribute-??? ?05 ?03)
                            (attribute-??? ?06 ?03))))))))

(and (doc make-design-of-adornments -1
       "The occurrence of Make Design of Adornments in the Dec-157.1 schematic")
       (forall ?a
           (activation-of ?a make-design-of-adornments -1)
           (activation-of ?a make-design-of-adornments)))

(foreall ?a
    (=>(activation-of ?a make-design-of-adornments -1)
        (exists ?p
            (=> (activation-of ?p decomposition 157.1)
                (subactivity-occurrence ?a ?p))))
(forall ?a
   (implies (activity-of ?a make-design-of-adornments-1)  
     (exists ?01
          (implies (exists ?02
                      (implies (exists ?03
                                    (implies (exists (instance-of ?01 building-mass/proposed-solution)  
                                              (instance-of ?02 regional-style)  
                                              (instance-of ?03 material-of-adornment))  
                                    (input-data ?01 ?a
                                                  (controls ?02 ?a)
                                                  (output-data ?03 ?a)))))))

   (forall ?03
     (implies (material-of-adornment ?03)
              (exists ?04
                     (exists ?05
                     (exists ?06
                     (exists (attribute-???? ?04 ?03)
                              (attribute-???? ?05 ?03)
                              (attribute-???? ?06 ?03)))))))))

(and (doc decomposition-116.1 "Make General façade Design")
    (and (subactivity evaluate-overall-design-1 decomposition-116 1)
         (and (subactivity make-detail-design-1 decomposition 116 1)
              (and (subactivity check-compatibility-of-detail-design-1 decomposition-116 1)
                   (and (subactivity do-additional-tasks-1 decomposition-116.1)
                        (and (subactivity design-for-production-1 Decomposition-116 1)
                             (def-process decomposition-116 1))))))

(and (doc evaluate-overall-design-1
       "The occurrence of Evaluate Overall Design in the Dec-116 1 schematic")
    (and (forall ?a
             (implies (activity-of ?a evaluate overall design -1)
                      (activity-of ?a evaluate overall design)))

    (forall ?a
             (implies (activity-of ?a evaluate overall design -1)
                      (exists ?p
                       (implies (activity-of ?p decomposition 116 1)
                                (subactivity-occurrence ?a ?p))))))

(and (doc make-detail-design-1
       "The Occurrence of Make Detail Design in the Dec-116 1 schematic")
    (and (forall ?a
             (implies (activity-of ?a make-detail-design -1)
                      (activity-of ?a make-detail-design)))

    (forall ?a
             (implies (activity-of ?a make-detail-design -1)
                      (exists ?p
                       (implies (activity-of ?p decomposition 116 1)
                                (subactivity-occurrence ?a ?p))))))

    (forall ?a
             (implies (activity-of ?a make-detail-design -1)
                      (activity-of ?a decomposition188.1))))
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(and (doc check-compatibility-of-detail-design-1
   "The occurrence of Check Compatibility of Detail Design in the Dec-116 1 schematic")
   (and (forall ?a
         (=>(activation-of ?a check-compatibility-of-detail-design-1)
             (activation-of ?a check-compatibility-of-detail-design-1))))

   (forall ?a
     (=>(activation-of ?a check-compatibility-of-detail-design-1)
         (exists ?p
          (=> (activation-of ?p decomposition 116 1)
               (subactivity-occurrence ?a ?p)))))))

(and (doc do-additional-tasks-1
   "The occurrence of Do Additional Tasks in the Dec-116 1 schematic")
   (and (forall ?a
         (=>(activation-of ?a do-additional-tasks -1)
             (activation-of ?a do-additional-tasks-1))))

   (forall ?a
     (=>(activation-of ?a do-additional-tasks -1)
         (exists ?p
          (=> (activation-of ?p decomposition 116 1)
               (subactivity-occurrence ?a ?p)))))))

(and (doc design-for-production-1
   "The occurrence of Design For Production in the Dec-116 1 schematic")
   (and (forall ?a
         (=>(activation-of ?a design-for-production-1)
             (activation-of ?a design-for-production-1))))

   (forall ?a
     (=>(activation-of ?a design-for-production-1)
         (exists ?p
          (=> (activation-of ?p decomposition 116 1)
               (subactivity-occurrence ?a ?p)))))))

(and (doc decomposition-188.1 "Make Detail Design")
   (and (subactivity make-detail-design-of-spaces -1 decomposition-188 1)
     (and (subactivity make-detail-design-of-facade-1 decomposition 188 1)
       (and (subactivity make-detail-design-of-structural-elements-1 decomposition 188 1)
         (and (subactivity make-detail-design-of-roof-1 decomposition 188.1)
           (and (subactivity make-detail-design-of-surface-structures-&-finishes-1 decomposition 188 1)
             (and (subactivity prepare-construction-specifications-1 decomposition-188.1)
               (ifdef-process decomposition 188.1)))))))))
(and (doc make-detail-design-of-spaces-1
        "The Occurrence of Make Detail Design of Spaces in the Dec-188.1 schematic")
    (and (forall ?a
          (=>(activation-of ?a make-detail-design-of-spaces-1)
              (activation-of ?a make-detail-design-of-spaces)))
    (and (forall ?a
          (=>(activation-of ?a make-detail-design-of-spaces-1)
              (exists ?p
               (=> (activation-of ?p decomposition 188.1)
                   (subactivity-occurrence ?a ?p)))))
    (forall ?a
       (=>(activation-of ?a make-detail-design-of-spaces-1)
           (activation-of ?a decomposition 192.1)))))

(and (doc make-detail-design-of-facade-1
       "The Occurrence of Make Detail Design of Facade in the Dec-188.1 schematic")
    (and (forall ?a
          (=>(activation-of ?a make-detail-design-of-facade-1)
              (activation-of ?a make-detail-design-of-facade)))
    (and (forall ?a
          (=>(activation-of ?a make-detail-design-of-facade-1)
              (exists ?p
               (=> (activation-of ?p decomposition 188.1)
                   (subactivity-occurrence ?a ?p)))))
    (forall ?a
       (=>(activation-of ?a make-detail-design-of-facade-1)
           (activation-of ?a decomposition 193.1)))))

(and (doc make-detail-design-of-structural-elements-1
       "The occurrence of Assist in Design of Structural-elements in the Dec-188.1 schematic")
    (and (forall ?a
          (=>(activation-of ?a make-detail-design-of-structural-elements-1)
              (activation-of ?a make-detail-design-of-structural-elements)))
    (forall ?a
       (=>(activation-of ?a make-detail-design-of-structural-elements-1)
           (exists ?p
            (=> (activation-of ?p decomposition 188.1)
                (subactivity-occurrence ?a ?p)))))
    (forall ?a
       (=>(activation-of ?a make-detail-design-of-structural-elements-1)
           (activation-of ?a decomposition-194.1)))))

(and (doc decomposition-194.1 "Make Detail Design of Structural-Elements")
    (and (subactivity make-detail-design-of-beam-1 decomposition-194.1)
        (and (subactivity make-detail-design-of-columns-1 decomposition-194.1)
            (and (subactivity make-detail-design-of-wall-1 decomposition-194.1)
                (and (subactivity make-detail-design-of-slab-1 decomposition-194.1)
                    (and (subactivity make-detail-design-of-foundation-1 decomposition-194.1)
                        (and (subactivity prepare-construction-specifications-1 decomposition-194.1)
                            (idef-process decomposition-194.1)))))))
(and (doc make-detail-design-of-beam -1
  “The occurrence of Make-Detail-Design-of-Beam in the Dec-194 1 schematic”)
  (and (forall ?a
         (=>(activation-of ?a make-detail-design-of-beam -1)
             (activation-of ?a make-detail-design-of-beam))))

(forall ?a
  (=>(activation-of ?a make-detail-design-of-beam -1)
      (exists ?p
       (=> (activation-of ?p decomposition 194 1)
           (subactivity-occurrence ?a ?p))))))

(and (doc make-detail-design-of-column-1
  “The occurrence of Make-Detail-Design-of-Column in the Dec-194 1 schematic”)
  (and (forall ?a
         (=>(activation-of ?a make-detail-design-of-column-1)
             (activation-of ?a make-detail-design-of-column))))

(forall ?a
  (=>(activation-of ?a make-detail-design-of-column-1)
      (exists ?p
       (=> (activation-of ?p decomposition 194 1)
           (subactivity-occurrence ?a ?p))))))

(forall ?a
  (=>(activation-of ?a make-detail-design-of-column-1)
      (exists ?01
       (exists ?02
        (exists ?03
         (=> (and (instance-of ?01 design-form-all-other-disciplines)
                  (instance-of ?02 over-all-design/code/)
                  (instance-of ?03 column))
             (and (input-data ?01 ?a)
                  (controls ?02 ?a)
                  (output-data ?03 ?a))))))

(and (forall ?03
         (=>(column ?03)
             (exists ?04
              (exists ?05
               (exists ?06
                (exists ?07
                 (exists ?08
                  (=> (and (attribute-type ?04 ?03)
                              (attribute-dimension ?05 ?03)
                              (attribute-material ?06 ?03)
                              (attribute-finish ?07 ?03)
                              (attribute-fire-rating ?08 ?03))))))))))

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(and (doc make-detail-design-of-wall-1
  "The occurrence of Make-Detail-Design-of-Wall in the Dec-194 1 schematic")
  (forall ?a
    (=>(activation-of ?a make-detail-design-of-wall-1)
      (exists ?p
        (=> (activation-of ?p decomposition 194.1)
          (subactivity-occurrence ?a ?p)))))))

(forall ?a
  (=>(activation-of ?a make-detail-design-of-wall-1)
    (exists ?p
      (=> (activation-of ?p decomposition 194.1)
        (subactivity-occurrence ?a ?p)))))))

(and (doc make-detail-design-of-slab-1
  "The occurrence of Make-Detail-Design-of-Slab in the Dec-194 1 schematic")
  (forall ?a
    (=>(activation-of ?a make-detail-design-of-slab-1)
      (activation-of ?a make-detail-design-of-slab)))

(forall ?a
  (=>(activation-of ?a make-detail-design-of-slab-1)
    (exists ?p
      (=> (activation-of ?p decomposition 194.1)
        (subactivity-occurrence ?a ?p)))))))

(and (doc make-detail-design-of-foundation-1
  "The occurrence of Make-Detail-Design-of-Foundation in the Dec-194 1 schematic")
  (forall ?a
    (=>(activation-of ?a make-detail-design-of-foundation-1)
      (activation-of ?a make-detail-design-of-foundation)))

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(forall ?a
  (=>(activation-of ?a make-detail-design-of-foundation -1)
      (exists ?p
       (=> (activation-of ?p decomposition 194 1)
           (subactivity-occurrence ?a ?p))))))

(and (doc make-detail-design-of-roof-1
      "The Occurrence of Make Detail Design of Roof in the Dec-188 1 schematic")
      (forall ?a
       (=>(activation-of ?a make-detail-design-of-roof -1)
           (activation-of ?a make-detail-design-of-roof)))
      (forall ?a
       (=>(activation-of ?a make-detail-design-of-roof -1)
           (exists ?p
            (=> (activation-of ?p decomposition 188 1)
                (subactivity-occurrence ?a ?p))))))

(and (doc make-detail-design-of-surface-structures-&-finishes-1
      "The occurrence of Make Detail Design of Surface Structures & Finishes in the Dec-188 1 schematic")
      (forall ?a
       (=>(activation-of ?a make-detail-design-of-surface-structures-&-finishes -1)
           (activation-of ?a make-detail-design-of-surface-structures-&-finishes)))

(forrall ?a
  (=>(activation-of ?a make-detail-design-of-surface-structures-&-finishes -1)
      (exists ?p
       (=> (activation-of ?p decomposition 188.1)
           (subactivity-occurrence ?a ?p))))))

(and (doc prepare-construction-specifications-1
      "The occurrence of Prepare Construction Specifications in the Dec-188 1 schematic")
      (forall ?a
       (=>(activation-of ?a prepare-construction-specifications -1)
           (activation-of ?a prepare-construction-specifications)))

(forrall ?a
  (=>(activation-of ?a prepare-construction-specifications -1)
      (exists ?p
       (=> (activation-of ?p decomposition 188.1)
           (subactivity-occurrence ?a ?p)))))))
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(and (doc decomposition-192.1 "Make Detail Design of Spaces")
  (and (subactivity delineate-defined-spaces-1 decomposition-192.1)
    (and (subactivity determine-partition-types-1 decomposition 192.1)
      (and (subactivity carry-out-egress analysis-1 decomposition-192.1)
        (and (subactivity place-opening-to-internal-enclosing-structures -1 Decomposition-192.1)
          (and (subactivity designate-spaces-openings-enclosing-&-
            complimentary-structures-1 decomposition-192.1)
            (and (subactivity make-detail-design-of-space-items-1 decomposition-192.1)
              (and (subactivity J1-1 decomposition-192.1)
                (and (subactivity J2-1 decomposition-192.1)
                  (and (subactivity J3-1 decomposition-192.1)
                    (and (subactivity J4-1 decomposition-192.1)
                      (and (subactivity J5-1 decomposition-192.1)
                        (idef-process decomposition-192.1)))))))))))))))

(and (doc delineate-defined-spaces-1 "The occurrence of Delineate Defined Spaces in the Dec-192.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a delineate-defined-spaces-1)
      (activation-of ?a delineate-defined-spaces))))

(forexists ?p
  (exists ?a
    (activation-of ?a delineate-defined-spaces-1)
    (activation-of ?a delineate-defined-spaces))

(and (doc determine-partition-types-1 "The occurrence of Determine Partition Types in the Dec-192.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a determine-partition-types-1)
      (activation-of ?a determine-partition-types)))

(forexists ?p
  (exists ?a
    (activation-of ?a determine-partition-types-1)
    (activation-of ?a determine-partition-types)))

(and (doc layout-partition-types-1 "The occurrence of Layout Partition Types in the Dec-192.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a layout-partition-types-1)
      (activation-of ?a layout-partition-types)))

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(forall ?a
  (=>(activation-of ?a layout-partition-types-1)
      (exists ?p
       (=> (activation-of ?p decomposition 192 1)
           (subactivity-occurrence ?a ?p))))))

(and (doc carry-out-egress-analysis-1
      "The occurrence of Carry Out Egress Analysis in the Dec-192 1 schematic")
  (forall ?a
   (=>(activation-of ?a carry-out-egress-analysis -1)
       (activation-of ?a carry-out-egress-analysis)))

(forall ?a
  (=>(activation-of ?a carry-out-egress-analysis -1)
      (exists ?p
       (=> (activation-of ?p decomposition 192 1)
           (subactivity-occurrence ?a ?p))))))

(and (doc place-opening-to-internal-enclosing-structures-1
      "The occurrence of Place Opening to Internal Enclosing Structures in the Dec-192 1 schematic")
  (forall ?a
   (=>(activation-of ?a place-opening-to-internal-enclosing-structures -1)
       (activation-of ?a place-opening-to-internal-enclosing-structures)))

(forall ?a
  (=>(activation-of ?a place-opening-to-internal-enclosing-structures -1)
      (exists ?p
       (=> (activation-of ?p decomposition 192.1)
           (subactivity-occurrence ?a ?p))))))

(and (doc designate-spaces-openings-enclosing-&-complimentary-structures-1
      "The occurrence of Designate Spaces, Openings, Enclosing & Complimentary Structures in the
      Dec-192 1 schematic")
  (forall ?a
   (=>(activation-of ?a designate-spaces-openings-enclosing-&-complimentary-structures-1)
       (activation-of ?a designate-spaces-openings-enclosing-&-complimentary-structures)))

(forall ?a
  (=>(activation-of ?a designate-spaces-openings-enclosing-&-complimentary-structures-1)
      (exists ?p
       (=> (activation-of ?p decomposition 192 1)
           (subactivity-occurrence ?a ?p))))))

(and (doc place-opening-to-internal-enclosing-structures-1
      "The occurrence of Place Opening to Internal Enclosing Structures in the Dec-192.1 schematic")
  (forall ?a
   (=>(activation-of ?a place-opening-to-internal-enclosing-structures -1)
       (activation-of ?a place-opening-to-internal-enclosing-structures)))

(forall ?a
  (=>(activation-of ?a place-opening-to-internal-enclosing-structures -1)
      (exists ?p
       (=> (activation-of ?p decomposition 192.1)
           (subactivity-occurrence ?a ?p))))))

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(and (doc make-detail-design-of-space-items-I
"The Occurrence of Make Detail Design of Space Items in the Dec-188.1 schematic")
(and (forall ?a
  (=>(activation-of ?a make-detail-design-of-space-items-I)
      (activation-of ?a make-detail-design-of-space-items)))
  (forall ?a
   (=>(activation-of ?a make-detail-design-of-space-items-I)
       (exists ?p
        (=> (activation-of ?p decomposition 188.1)
            (subactivity-occurrence ?a ?p)))))

(forall ?a
  (=>(activation-of ?a make-detail-design-of-space-items-I)
      (activation-of ?a decomposition204.1)))

(and (doc decomposition-204.1 "Make Detail Design of Spaces Items")
  (and (subactivity make-detail-design-of-partition-structures-1 decomposition-204.1)
      (and (subactivity make-detail-design-of-complimentary-structures-to-internal-openings-1
decomposition-204.1)
           (and (subactivity make-detail-design-of-items-&-fittings-on-space-I decomposition-204.1)
                (idef-process decomposition-204.1))))

(and (doc make-detail-design-of-partition-structures-1
"The occurrence of Make Detail Design of Partition Structures in the Dec204.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a make-detail-design-of-partition-structures-1)
        (activation-of ?a make-detail-design-of-partition-structures)))
  (forall ?a
    (=>(activation-of ?a make-detail-design-of-partition-structures-1)
        (exists ?p
         (=> (activation-of ?p decomposition 204.1)
             (subactivity-occurrence ?a ?p))))))

(and (doc make-detail-design-of-complimentary-structure-to-internal-openings-1
"Make Detail Design of Complimentary Structures to Internal Openings in the Dec204.1 schematic")
  (and (forall ?a
    (=>(activation-of ?a make-detail-design-of-complimentary-structure-to-internal-openings-1)
        (activation-of ?a make-detail-design-of-complimentary-structure-to-internal-openings)))
  (forall ?a
    (=>(activation-of ?a make-detail-design-of-complimentary-structure-to-internal-openings-1)
       (exists ?p
        (=> (activation-of ?p decomposition 204.1)
            (subactivity-occurrence ?a ?p))))))

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(and (doc make-detail-design-of-items-&-fittings-on-space-1 "Make Detail Design of Items & Fittings on Space in the Dec204 1 schematic")
(and (forall ?a
(=>(activation-of ?a make-detail-design-of-items-&-fittings-on-space -1)
(activation-of ?a make-detail-design-of-items-&-fittings-on-space)))
(forall ?a
(=>(activation-of ?a make-detail-design-of-items-&-fittings-on-space -1)
(exists ?p
(=> (activation-of ?p decomposition 204 1)
(subactivity-occurrence ?a ?p))))))

(and (doc make-detail-design-of-space-floor-structures-1 "Make Detail Design of Space Floor Structures in the Dec204 1 schematic")
(and (forall ?a
(=>(activation-of ?a make-detail-design-of-space-floor-structures -1)
(activation-of ?a make-detail-design-of-space-floor-structures)))
(forall ?a
(=>(activation-of ?a make-detail-design-of-space-floor-structures -1)
(exists ?p
(=> (activation-of ?p decomposition 204 1)
(subactivity-occurrence ?a ?p))))))

(and (doc decomposition-193.1 "Make Detail Design of Facade")
(and (subactivity make-detail-design-of-external-enclosing-structures-193 1)
(and (subactivity make-detail-design-of-projecting-fa~ade-structures-1 decomposition 193.1))
(and (subactivity make-detail-design-of-complimentary-structures-1 decomposition-193.1)
(and (subactivity make-detail-design-of-adornments-1 decomposition-193 1)
((def-process decomposition-193 1))))))

(and (doc make-detail-design-of-external-enclosing-structureswall-1 "Make Detail Design of External Enclosing Structure/wall in the Dec 193 1 schematic")
(and (forall ?a
(=>(activation-of ?a make-detail-design-of-external-enclosing-structure/wall-1)
(activation-of ?a make-detail-design-of-external-enclosing-structure/wall)))
(forall ?a
(=>(activation-of ?a make-detail-design-of-external-enclosing-structure/wall-1)
(exists ?p
(=> (activation-of ?p decomposition 193.1)
(subactivity-occurrence ?a ?p)))))

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(forall ?a
  (=>(activation-of ?a make-detail-design-of-external-enclosing-structure/wall-1)
      (exists ?01
        (exists ?02
          (exists ?03
            (=> (instance-of ?01 general-façade-design)
                (instance-of ?02 contractor-instruction)
                (instance-of ?03 façade/external-wall-type))
            (and (input-data ?01 ?a)
                (controls ?02 ?a)
                (output-data ?03 ?a))))))

(and (forall ?a
  (=>(activation-of ?a make-detail-design-of-projecting-façade-structures-1)
      (activation-of ?a make-detail-design-of-projecting-façade-structures)))

(forall ?a
  (=>(activation-of ?a make-detail-design-of-projecting-façade-structures-1)
      (exists ?p
        (activation-of ?p decomposition 193 1)
        (subactivity-occurrence ?a ?p))))))

(and (doc make-detail-design-of-complimentary-structures-1
  " Make Detail Design of Complimentary Structures in the Dec 193 1 schematic")
  (and (forall ?a
  (=>(activation-of ?a make-detail-design-of-complimentary-structures-1)
      (activation-of ?a make-detail-design-of-complimentary-structures)))

(forall ?a
  (=>(activation-of ?a make-detail-design-of-complimentary-structures-1)
      (exists ?p
        (activation-of ?p decomposition 193 1)
        (subactivity-occurrence ?a ?p))))))

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(forall ?a
 (=>(activation-of ?a make-detail-design-of-complimentary-structures-1)
  (exists ?01
  (exists ?02
  (exists ?03
   (=) (and (instance-of ?01 general-façade-design)
            (instance-of ?02 overall design/environment/manufacturers specification)
            (instance-of ?03 complimentary-structures)))
   (and (input-data ?01 ?a)
        (controls ?02 ?a)
        (output-data ?03 ?a))))))
(and (forall ?03
   (=>(complimentary-structure ?03)
       (exists ?04
         (exists ?05
           (exists ?06
             (exists ?07
               (exists ?08
                 (exists ?09
                   (exists ?10
                     (exists ?11
                       (exists ?12
                         (exists ?13
                           (=) (and (attribute-type ?04 ?03)
                                 (attribute-dimension ?05 ?03)
                                 (attribute-material ?06 ?03)
                                 (frame ?07 ?03)
                                 (hardware ?08 ?03)
                                 (attribute-finish ?08 ?03)
                                 (attribute-swing ?09 ?03)
                                 (attribute-fire-rating ?010 ?03)
                                 (glazing ?11 ?03)
                                 (sill ?12 ?03)
                                 (head ?13 ?03)))))))))))))
(and (doc make-detail-design-of-adornments-1
       " Make Detail Design of Adornments in the Dec 193.1 schematic")
    (and (forall ?a
           (=>(activation-of ?a make-detail-design-of-adornments-1)
               (activation-of ?a make-detail-design-of-adornments-1)))
    (forall ?a
            (=>(activation-of ?a make-detail-design-of-adornments-1)
                (exists ?p
                 (=>(activation-of ?p decomposition 193.1)
                     (subactivity-occurrence ?a ?p))))))))
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(and (doc decomposition-195 1 "Make Detail Design of Roof Structure")
  (and (subactivity layout roof-1 decomposition-195 1)
    (and (subactivity layout roof clear story windows-1 decomposition 195 1)
      (and (subactivity layout space for services & other programmes-1 decomposition-195 1)
        (and (subactivity design drainage -1 decomposition-195 1)
          (and (subactivity make detail design of roof structural elements & assemblies-1
            Decomposition- 195 1)
            (and (subactivity J1-1 decomposition-195 1)
              (def-process decomposition-195 ))))))))

(and (doc layout-roof-1 "Layout Roof in the Dec 195 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a layout-roof-1)
      (activation-of ?a layout-roof)))
    (forall ?a
      (=>(activation-of ?a layout-roof -1)
        (exists ?p
          (=> (activation-of ?p decomposition 195 1)
            (subactivity-occurrence ?a ?p))))))

(and (doc layout-roof-clear-story-windows -1 "Layout Roof Clear Story Windows in the Dec 195 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a layout-roof-clear-story-windows -1)
      (activation-of ?a layout-roof-clear-story-windows)))
    (forall ?a
      (=>(activation-of ?a layout-roof-clear-story-windows-1)
        (exists ?p
          (=> (activation-of ?p decomposition 195 1)
            (subactivity-occurrence ?a ?p))))))

(and (doc layout-space-for-services-&-other-programmes -1 "Layout Space for Services & Other Programmes in the Dec 195 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a layout-space-for-services-&-other-programmes -1)
      (activation-of ?a layout-space-for-services-&-other-programmes)))
    (forall ?a
      (=>(activation-of ?a layout-space-for-services-&-other-programmes-1)
        (exists ?p
          (=> (activation-of ?p decomposition 195 1)
            (subactivity-occurrence ?a ?p))))))

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(and (doc design-drainage -1
  "Design Drainage in the Dec 195 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a design-drainage -1)
      (activation-of ?a design-drainage))))

(foreall ?a
  (=>(activation-of ?a design-drainage -1)
    (exists ?p
      (=> (activation-of ?p decomposition 195 1)
        (subactivity-occurrence ?a ?p))))))

(and (doc make-detail-design-of-roof-structural-elements-&-assemblies -1
  "the occurrence of make detail design of roof structural elements & assemblies in the Dec 195 1 schematic")
  (and (forall ?a
    (=>(activation-of ?a make-detail-design-of-roof-structural-elements-&-assemblies-1)
      (activation-of ?a make-detail-design-of-roof-structural-elements-&-assemblies))))

(foreall ?a
  (=>(activation-of ?a make-detail-design-of-roof-structural-elements-&-assemblies-1)
    (exists ?p
      (=> (activation-of ?p decomposition 195 1)
        (subactivity-occurrence ?a ?p))))))
(doc pre-tender procedure "Pre-Tender Procedure")

(and (doc pre-tender procedure "The Top Level Pre-Tender Procedure schematic")
  (and (subactivity pre-tender procedure-1 pre-tender procedure)
    (idef-process pre-tender procedure)))

(and (doc pre-tender procedure-1 "The occurrence of Pre-Tender Procedure in the schematic")
  (and (forall ?a
    (=activation of ?a pre-tender procedure-1)
    (activation of ?a pre-tender procedure)))
  (and (forall ?a
    (=activation of ?a pre-tender procedure-1)
    (activation of ?a decomposition-1.1)))
  (and (forall ?a
    (=activation of ?a pre-tender procedure-1)
    (exists ?01
     (exists ?02
      (exists ?03
       (= (instance-of ?01 tender-document)
          (instance-of ?02 condition-of-tender)
          (instance-of ?03 tender-file))
       (input-data ?01 ?a)
       (controls ?02 ?a)
       (output-data ?03 ?a))))
    (forall ?03
     (= (tender-file ?03)
        (exists ?04
         (exists ?05
          (exists ?06
           (exists ?07
            (= (---------- ?04 ?03)
               (---------- ?05 ?03)
               (---------- ?06 ?03)
               (---------- ?07 ?03))))))))

(and (doc decomposition-1.1 "Decomposition of Pre-Tender Procedure")
  (and (subactivity review tender invitation-1 decomposition-1.1)
    (and (subactivity make decision to tender-1 decomposition-1.1)
      (and (subactivity decline invitation to tender-1 decomposition-1.1)
        (and (subactivity accept estimate to tender-1 decomposition-1.1)
          (and (subactivity plan tender-1 decomposition-1.1)
            (and (subactivity build up complete estimate to decomposition-1.1)
              (and (subactivity finalise tender decomposition-1.1)
                (and (subactivity J1 decomposition-1.1)
                  (and (subactivity J2 decomposition-1.1)
                    (and (subactivity J3 decomposition-1.1)
                      (idef-process decomposition-1.1))))))))))

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(and (doc review tender invitation -1
      "the occurrence of review tender invitation in the Dec 8 schematic")
      (and (forall ?a
            (=>(activation-of ?a review tender invitation -1)
                (activation-of ?a review tender invitation)))
            (forall ?a
              (=>(activation-of ?a review tender invitation-1)
                  (exists ?p
                    (=> (activation-of ?p decomposition 8 1)
                        (subactivity-occurrence ?a ?p)))))
            (forall ?a
              (=>(activation-of ?a review tender invitation-1)
                  (exists ?01
                    (exists ?02
                      (=> (and (instance-of ?01 invitation-to-tender)
                              (instance-of ?02 tender-review))
                          (and (input-data ?01 ?a)
                               (output-data ?03 ?a)))))))
            (and (forall ?03
                  (=>(tender-file ?03)
                      (exists ?04
                        (exists ?05
                          (=> (and -------------- 04 03)
                              (------------ 05 03)))))
                  (and (doc make decision to tender-1
                        "the occurrence of make decision to tender in the Dec 8 schematic")
                        (and (forall ?a
                               (=>(activation-of ?a make decision to tender -1)
                                   (activation-of ?a make decision to tender)))
                               (forall ?a
                                 (=>(activation-of ?a make decision to tender -1)
                                     (exists ?p
                                       (=> (activation-of ?p decomposition 8 1)
                                            (subactivity-occurrence ?a ?p)))))))

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(forall ?a
  (=>(activation-of ?a make decision to tender-1)
  (and (doc pre-tender procedure-1 "The occurrence of Pre-Tender Procedure in the schematic")
  (and (forall ?a
  (=>activation of ?a pre-tender procedure-1)
  (activation of ?a pre-tender procedure)))
  (and (forall ?a
  (=>activation of ?a pre-tender procedure-1)
  (activation of ?a decomposition-1 1)))
  (and (forall ?a
  (=>activation of ?a pre-tender procedure-1)
  (exists ?01
  (exists ?02
  (exists ?03
  (=> (and (instance-of ?01 tender-invitation-review)
  (instance-of ?02 work-load
  type-of-work
  location-of-proposed-work
  expected-competition)
  (instance-of ?03 letter-of-acceptance-or-decline))
  (and (input-data ?01 ?a)
  (controls ?02 ?a)
  (output-data ?03 ?a)))))))

(and (doc decline invitation to tender-1
  "the occurrence of decline invitation to tender in the Dec 8.1 schematic")
  (and (forall ?a
  (=>(activation-of ?a decline invitation to tender -1)
  (activation-of ?a decline invitation to tender)))
  (forall ?a
  (=>(activation-of ?a decline invitation to tender -1)
  (exists ?p
  (=> (activation-of ?p decomposition 8 1)
  (subactivity-occurrence ?a ?p))))))

(forall ?a
  (=>(activation-of ?a decline invitation to tender -1)
  (exists ?01
  (exists ?02
  (exists ?03
  (=> (and (instance-of ?01 statement-of-decision-to-tender)
  (instance-of ?02 tender-invitation-condition)
  (instance-of ?03 letter-of-decline))
  (and (input-data ?01 ?a)
  (controls ?02 ?a)
  (output-data ?03 ?a))))))

(and (doc accept invitation to tender -1
  "the occurrence of accept invitation to tender in the Dec 8.1 schematic")
  (and (forall ?a
  (=>(activation-of ?a accept invitation to tender -1)
  (activation-of ?a accept invitation to tender)))
  (forall ?a
  (=>(activation-of ?a accept invitation to tender -1)
  (exists ?p
  (=> (activation-of ?p decomposition 8 1)
  (subactivity-occurrence ?a ?p))))))

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(forall ?a
  (=>(activation-of ?a accept invitation to tender -1)
    (exists ?01
     (exists ?02
      (exists ?03
       (=> (and (instance-of ?01 statement-of-decision-to-tender)
             (instance-of ?02 tender-invitation-condition)
             (instance-of ?03 letter-of-acceptance))
        (and (input-data ?01 ?a)
             (controls ?02 ?a)
             (out-put data ?03 ?a)))))))))

(and (doc estimate tender -1 " The occurrence of Estimate Tender in the Dec-1.1 schematic")
  (and (forall ?a
        (=> (activation-of ?a estimate tender -1)
            (activation-of ?a estimate tender)))
        (forall ?a
         (=>(activation-of ?a estimate tender -1)
             (exists ?p
              (=> activation-of ?p decomposition-1 l)
              (subactivity-occurrence ?a ?p)))
         (and forall ?a
          (=>(activation-of ?a estimate tender -1)
              (activation-of ?a decomposition 8 l)))))))))

(and forall ?a
  (=>(activation-of ?a estimate tender -1)
      (exists ?01
       (exists ?02
        (exists ?03
         (=> (and (instance-of ?01 tender-document
tender-summary-sheet)
                  (instance-of ?02 condition-of-tender/form-form-of-contract)
                  (instance-of ?03 unit-rates/quotations))
             (and (input-data ?01 ?a)
                 (controls ?02 ?a)
                 (out-put data ?03 ?a)))))))))))

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(and (doc plan tender -1
  " The occurrence of plan tender in the Dec-1 1 schematic")
  (and (forall ?a
    (=> (activation-of ?a plan tender -1)
        (activation-of ?a plan tender)))
    (forall ?a
     (=>(activation-of ?a plan tender -1)
         (exists ?p
          (=> activation-of ?p decomposition-1 1)
          (subactivity-occurrence ?a ?p)))
    (and forall ?a
     (=>(activation-of ?a estimate tender -1)
         (activation-of ?a decomposition 9 1))))))))
  (and (doc build up complete estimate -1
    " The occurrence of build up complete estimate in the Dec-1 1 schematic")
    (and (forall ?a
      (=> (activation-of ?a build up complete estimate -1)
          (activation-of ?a build up complete estimate)))
      (forall ?a
       (=>(activation-of ?a build up complete estimate -1)
           (exists ?p
            (=> activation-of ?p decomposition-1 1)
            (subactivity-occurrence ?a ?p)))
      (and forall ?a
       (=>(activation-of ?a build up complete estimate -1)
           (activation-of ?a decomposition 10 1))))))
    (and forall ?a
     (=>(activation-of ?a build up complete estimate -1)
         (exists ?01
          (exists ?02
           (exists ?03
            (=> (and (Instance-of ?01 BoQs
                       unite-rates
                       primary-schedule
                       quotations)
                (Instance-of ?02 condition-of-tender/instruction)
                (Instance-of ?03 complete-estimate))
            (Input-data ?01 ?a)
            (controls ?02 ?a)
            (out-put data ?03 ?a)))))))))))

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(and (doc finalise tender -1
" The occurrence of finalise tender in the Dec-1 1 schematic")
(and (forall ?a
  (=> (activation-of ?a finalise tender -1)
       (activation-of ?a finalise tender)))
  (forall ?a
   (=>(activation-of ?a finalise tender -1)
       (exists ?p
        (=> activation-of ?p decomposition-1 1)
        (subactivity-occurrence ?a ?p))))))

(forall ?a
  (=>(activation-of ?a finalise tender -1)
      (exists '01
               '02
               '03
      (=> (and (instance-of '01 completed-estimate
                   negatived-savings-&-expected-margins-on-subs)
           (instance-of '02 condition-of-tender/instruction)
           (instance-of '03 tender-file))
      (and (input-data '01 ?a)
           (controls '02 ?a)
           (out-put data '03 ?a)))))))))

(and (doc j1 "J1")
  (and (forall ?J
        (=>(activation-of ?J j1)
            (exists ?p
             (=>(activation-of ?p decomposition 1.1)
                 (subactivity-occurrence ?J ?p))))
             (and (follows make declslon to tender j1 decomposition-1 1)
                   (and (xor_split j1 decomposition 1.1)
                        (and (subactivity decline invitation to tender j1)
                             (and (subactivity accept invitation to tender j1))))))))

(and (doc j2 "J2")
  (and (forall ?J
        (=>(activation-of ?J j2)
            (exists ?p
             (=>(activation-of ?p decomposition 1.1)
                 (subactivity-occurrence ?J ?p))))
             (and (follows accept invitation to tender j2 decomposition-1.1)
                   (and (and_split j2 decomposition 1 1)
                        (and (subactivity estimate tender j2)
                             (and (subactivity plan tender j2))))))))

(and (doc j3 "J3")
  (and (forall ?J
        (=>(activation-of ?J j3)
            (exists ?p
             (=>(activation-of ?p decomposition 1 1)
                 (subactivity-occurrence ?J ?p))))

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(and (follows j3 build up complete estimate decomposition-1 1)
  (and (and_split j3 decomposition-1 1)
    (and (subactivity estimate tender j3)
      (and (subactivity plan tender j3)))))))))

(and (doc decomposition-8 1 "Decomposition of Estimate Tender")
  (and (subactivity examine document-1 decomposition-8 1)
    (and (subactivity collect relevant information-1 decomposition-8 1)
      (and (subactivity establish all-in-rates-1 decomposition-8 1)
        (and (subactivity build up unit rates-1 decomposition-8 1)
          (idef-process decomposition-8-1)))))))))

(and (doc examine document-1
    "The occurrence of examine document in the Dec-8 1 schematic")
  (and (forall ?a
    (=>'(activation-of ?a examine document -1)
      (activation-of ?a examine document-1)))
    (forall ?a
      (=>'(activation-of ?a examine document -1)
        (exists ?p
          (=>' activation-of ?p decomposition-8 1)
          (subactivity-occurrence ?a ?p))))))

(forall ?a
  (=>'(activation-of ?a examine document -1)
    (exists ?01
      (exists ?02
        (exists ?03
          (=>'(and (instance-of ?01 tender-document
                      tender-summary-sheet)
            (instance-of ?02 condition-of-tender/instruction)
            (instance-of ?03 tender-enquiry-abstract))
          (and (input-data ?01 ?a)
            (controls ?02 ?a)
            (output-data ?03 ?a)))))))))

(and (doc collect relevant information-1
    "The occurrence of collect relevant information in the Dec-8 1 schematic")
  (and (forall ?a
    (=>'(activation-of ?a collect relevant information -1)
      (activation-of ?a collect relevant information))
    (forall ?a
      (=>'(activation-of ?a collect relevant information -1)
        (exists ?p
          (=>' activation-of ?p decomposition-8.1)
          (subactivity-occurrence ?a ?p))))))

508
(forall ?a
   (=> (activation-of ?a collect relevant information -1)
        (exists ?01)
        (exists ?02)
        (exists ?03)
        (=> (and (instance-of ?01 tender-enquiry-abstract/quotations/insurance-premium)
                  (instance-of ?02 condition-of-tender/instruction)
                  (instance-of ?03 quotations/direct-work-abstracts))
        (and (input-data ?01 ?a)
             (controls ?02 ?a)
             (output-data ?03 ?a)))))

(and (doc collate quotations -1
   "The occurrence of collate quotations in the Dec-8.1 schematic")
   (forall ?a
         (=> (activation-of ?a collate quotations -1)
              (activation-of ?a collate quotations)))

(foreall ?a
   (=> (activation-of ?a collate quotations -1)
        (exists ?p)
        (=> activation-of ?p decomposition-8.1)
        (decomposition-activity occurrence ?a ?p)))

(foreall ?a
   (=> (activation-of ?a collate quotations -1)
        (exists ?01)
        (exists ?02)
        (exists ?03)
        (=> (and (instance-of ?01 quotations/trade-file)
                  (instance-of ?02 condition-of-tender/instruction)
                  (instance-of ?03 comparison-sheet/quotations))
        (and (input-data ?01 ?a)
             (controls ?02 ?a)
             (output-data ?03 ?a))))

(and (doc establish all-in-rates -1
   "The occurrence of establish all-in-rates in the Dec-8.1 schematic")
   (forall ?a
         (=> (activation-of ?a establish all-in-rates -1)
              (activation-of ?a establish all-in-rates)))

(foreall ?a
   (=> (activation-of ?a establish all-in-rates -1)
        (exists ?p)
        (=> activation-of ?p decomposition-8.1)
        (decomposition-activity occurrence ?a ?p))))
(forall ?a
  (=> (activation-of ?a establish all-in-rates -1)
      (exists ?01
       (exists ?02
        (exists ?03
         (=> (and (instance-of ?01 quotations
                     comparison-sheet
direct-work-abstracts)
                (instance-of ?02 condition-of-tender/instruction)
                (instance-of ?03 all-in-rates/quotations))
        (and (input-data ?01 ?a)
             (controls ?02 ?a)
             (output-data ?03 ?a)))))))))))

(and (doc build up unit rates -1
      "The occurrence of build up unit rates in the Dec-8 1 schematic")
      (forall ?a
       (=> (activation-of ?a build up unit rates -1)
           (activation-of ?a build up unit rates)))
       (forall ?a
       (=> (activation-of ?a build up unit rates -1)
           (exists ?p
            (=> (activation-of ?p decomposition-8 1)
                (subactivity-occurence ?a ?p)))))))))

(foreall ?a
  (=> (activation-of ?a build up unit rates -1)
      (exists ?01
       (exists ?02
        (exists ?03
         (=> (and (instance-of ?01 all-in-rates)
                  (instance-of ?02 condition-of-tender/instruction)
                  (instance-of ?03 unit-rate))
             (and (input-data ?01 ?a)
                  (controls ?02 ?a)
                  (output-data ?03 ?a)))))))))))

(and (doc decomposition-9.1 "Decomposition of Plan-Tender")
     (and (subactivity extract information-1 decomposition-9.1)
         (and (subactivity collect necessary information-1 decomposition-9.1)
             (and (subactivity resource bill of quantities-1 decomposition-9.1)
                 (and (subactivity draft pre-tender programme-1 decomposition-9.1)
                     (and (subactivity produce method statement-1 decomposition-9.1)
                         (and (subactivity produce preliminary schedule-1 decomposition-9.1)
                             (and (subactivity J1 decomposition-9 1)
                                 (and (subactivity J2 decomposition-9 1)
                                     (idef-process decomposition-9 1)))))))))

510
(and (doc extract information -I
"The occurrence of extract information in the Dec-9 1 schematic")
(and (forall ?a
  (=> (activation-of ?a extract information -I)
       (activation-of ?a extract information)))

(forall ?a
  (=>(activation-of ?a extract information -I)
      (exists ?p
       (=> activation-of ?p decomposition-9.1)
       (subactivity-occurrence ?a ?p)))))))

(forall ?a
  (=>(activation-of ?a extract information -I)
      (exists ?01
       (exists ?02
        (exists ?03
         (=> (and (instance-of ?01 tender-document
                          tender-summary-sheet)
              (instance-of ?02 preamble/specification)
              (instance-of ?03 bulk-quantities
                           plant-requirements-list
                           scaffolds-requirements-schedule))
         (and (input-data ?01 ?a)
              (controls ?02 ?a)
              (output-data ?03 ?a))))))))

(and (doc collect necessary information -I
"The occurrence of collect necessary information in the Dec-9 1 schematic")
(and (forall ?a
  (=> (activation-of ?a collect necessary information -I)
       (activation-of ?a collect necessary information)))

(forall ?a
  (=>(activation-of ?a collect necessary information -I)
      (exists ?p
       (=> activation-of ?p decomposition-9.1)
       (subactivity-occurrence ?a ?p)))))))

(forall ?a
  (=>(activation-of ?a collect necessary information -I)
      (exists ?01
       (exists ?02
        (exists ?03
         (=> (and (instance-of ?01 scaffolds-schedule
                                plant-requirements
                                temporary-work)
              (instance-of ?02 condition-of-tender/instructions)
              (instance-of ?03 temporary-work-details quantities))
         (and (input-data ?01 ?a)
              (controls ?02 ?a)
              (output-data ?03 ?a)))))))))

511
(and (doc resource-principal-activities-1
"The occurrence of resource bill of quantities in the Dec-9.1 schematic")
(and (forall ?a
(=> (activation-of ?a resource bill of quantities -1)
(activation-of ?a resource bill of quantities)))
(forall ?a
(=> (activation-of ?a resource bill of quantities -1)
(exists ?p
(=> activation-of ?p decomposition-9.1)
(subactivity-occurrence ?a ?p))))))

(forall ?a
(=> (activation-of ?a resource bill of quantities -1)
(exists ?01
(exists ?02
(exists ?03
(=> (and (instance-of ?01 bulk-quantities
temporary-work-details
s/c names)
(instance-of ?02 construction-method-selected)
(instance-of ?03 principal-activities
selected-method))
(and (input-data ?01 ?a)
(control ?02 ?a)
(output-data ?03 ?a)))))))))

(and (doc draft pre-tender programme-1
"The occurrence of draft pre-tender programme in the Dec-9.1 schematic")
(and (forall ?a
(=> (activation-of ?a draft pre-tender programme -1)
(activation-of ?a draft pre-tender programme)))
(forall ?a
(=> (activation-of ?a draft pre-tender programme -1)
(exists ?p
(=> activation-of ?p decomposition-9.1)
(subactivity-occurrence ?a ?p))))))

(forall ?a
(=> (activation-of ?a draft pre-tender programme -1)
(exists ?01
(exists ?02
(exists ?03
(=> (and (instance-of ?01 principal-activities)
(instance-of ?02 method-logic)
(instance-of ?03 programmed-duration))
(and (input-data ?01 ?a)
(control ?02 ?a)
(output-data ?03 ?a))))))))
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(and (doc produce method statement -1
" The occurrence of produce method statement in the Dec-9 1 schematic")
 (and (forall ?a
 (=> (activation-of ?a produce method statement -1)
 (activation-of ?a produce method statement)))

(forall ?a
 (=>(activation-of ?a produce method statement -1)
 (exists ?p
 (=> activation-of ?p decomposition-9 1)
 (subactivity-occurrence ?a ?p))))))

(forall ?a
 (=>(activation-of ?a produce method statement -1)
 (exists ?01
 (exists ?02
 (exists ?03
 (=> (and ( instance-of ?01 selected-method )
 ( instance-of ?02 recommendations)
 ( instance-of ?03 method-statement methods/logic))
 (and ( input-data ?01 ?a)
 ( controls ?02 ?a)
 ( out-put data ?03 ?a))))))))

(and (doc produce preliminary schedule -1
" The occurrence of produce preliminary schedule in the Dec-9 1 schematic")
 (and (forall ?a
 (=> (activation-of ?a produce preliminary schedule -1)
 (activation-of ?a produce preliminary schedule)))

(forall ?a
 (=>(activation-of ?a produce preliminary schedule -1)
 (exists ?p
 (=> activation-of ?p decomposition-9 1)
 (subactivity-occurrence ?a ?p))))))

(forall ?a
 (=>(activation-of ?a produce preliminary schedule -1)
 (exists ?01
 (exists ?02
 (exists ?03
 (=> (and ( instance-of ?01 programmed-duration
 method-statement
 draft-site-organisation-structures
 area-managers-reprogramme-&-preliminary-schdule)
 ( instance-of ?02 recommendations)
 ( instance-of ?03 primary-schedule))
 (and ( input-data ?01 ?a)
 ( controls ?02 ?a)
 ( out-put data ?03 ?a))))))))

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(and (doc J1 “J1”)  
(and (forall ?J  
(=>(activation-of ?J J1)  
(exists ?p  
(=>(activation-of ?p decomposition 9 1)  
(subactivity-occurrence ?J ?p))))  
(and (follows resource bill of quantities J1 decomposition-9 1)  
(and (xor_split J1 decomposition 9 1)  
(and (subactivity draft pre-tender programme J1)  
(and (subactivity produce method statement J1)))))))

(and (doc J2 “J2”)  
(and (forall ?J  
(=>(activation-of ?J J2)  
(exists ?p  
(=>(activation-of ?p decomposition 9 1)  
(subactivity-occurrence ?J ?p))))  
(and (follows J2 produce preliminary schedule decomposition-9 1)  
(and (and_split J2 decomposition 9 1)  
(and (subactivity draft pre-tender programme J2)  
(and (subactivity produce method statement J2)))))))

(and (doc decomposition-10 1 “Decomposition of Build up Complete Estimate”)  
(and (subactivity co-ordinate tender-1 decomposition-10 1)  
(and (subactivity price bill of quantities-1 decomposition-10 1)  
(and (subactivity price preliminary scheduel-1 decomposition-10.1)  
(and (subactivity make arithmetic check -1 decomposition-10 1)  
(and (subactivity review late quotations-1 decomposition-10 1)  
(and (subactivity summarise estimate-1 decomposition-10 1)  
(and (subactivity J1 decomposition-10 1)  
(and (subactivity J2 decomposition-10.1)  
(and (subactivity J3 decomposition-10 1)  
(def-process decomposition-10 1))))))))

(and (doc co-ordinate tender -1  
“The occurrence of co-ordinate tender in the Dec-10.1 schematic”)  
(and (forall ?a  
(=> (activation-of ?a co-ordinate tender -1)  
(activation-of ?a co-ordinate tender)))  
(forall ?a  
(=>(activation-of ?a co-ordinate tender -1)  
(exists ?p  
(=> activation-of ?p decomposition-10 1)  
(subactivity-occurecne ?a ?p)))))))

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(forall ?a
  (=⇒(activation-of ?a co-ordinate tender -I)
    (exists ?01
     (exists ?02
      (exists ?03
        (=⇒(and (instance-of ?01 quotations unit-rates preliminary-schedule)
          (instance-of ?02 conditions-of-contract)
          (instance-of ?03 quotations unit-rates preliminary-schedule))
        (and (input-data ?01 ?a)
          (controls ?02 ?a)
          (out-put data ?03 ?a))))))

(and (doc price bill of quantities -1
  " The occurrence of price bill of quantities in the Dec-10 I schematic")
  (forall ?a
    (=⇒(activation-of ?a price bill of quantities -I)
      (activation-of ?a price bill of quantities)))

(forall ?a
  (=⇒(activation-of ?a price bill of quantities -I)
    (exists ?p
     (=⇒activation-of ?p decomposition-10 I)
     (subactivity-occurence ?a ?p))))

(forall ?a
  (=⇒(activation-of ?a price bill of quantities -I)
    (exists ?01
     (exists ?02
      (exists ?03
        (=⇒(and (instance-of ?01 unit-rates/quotations)
          (instance-of ?02 conditions-of-contract)
          (instance-of ?03 measured-rates build-up-&_extension))
        (and (input-data ?01 ?a)
          (controls ?02 ?a)
          (out-put data ?03 ?a))))))

(and (doc price preliminary schedule -1
  " The occurrence of price preliminary schedule in the Dec-10 I schematic")
  (forall ?a
    (=⇒(activation-of ?a price preliminary schedule -I)
      (activation-of ?a price preliminary schedule)))

(forall ?a
  (=⇒(activation-of ?a price preliminary schedule -I)
    (exists ?p
     (=⇒activation-of ?p decomposition-10 I)
     (subactivity-occurence ?a ?p))))

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(forall ?a
  (=> (activation-of ?a price preliminary schedule -1)
       (exists ?01
            (exists ?02
                 (exists ?03
                      (=> (and ( instance-of ?01 primary-schedule/quotations)
                         ( instance-of ?02 conditions-of-contract)
                         ( instance-of ?03 priced-preliminaries
                                   build-up-&-extensions-&-work-sheet))
                      (and ( input-data ?01 ?a)
                           ( controls ?02 ?a)
                           ( out-put data ?03 ?a)))))))))

(and (doc make arithmetic check -1
" The occurrence of make arithmetic check in the Dec-10 1 schematic")
  (forall ?a
       (=> (activation-of ?a make arithmetic check -1)
            (activation-of ?a make arithmetic check))))

(forall ?a
  (=> (activation-of ?a make arithmetic check -1)
       (exists ?p
            (=> activation-of ?p decomposition-10.1)
            (subactivity-occurrence ?a ?p)))))

(forall ?a
  (=> (activation-of ?a make arithmetic check -1)
       (exists ?01
            (exists ?02
                 (exists ?03
                      (=> (and ( instance-of ?01 build-up-&-extensions-&-work-sheet
                                build-up-&-extensions)
                           ( instance-of ?02 conditions-of-contract)
                           ( instance-of ?03 verified-build-up-&-extensions-&-work-sheet
                                   verified-build-up-&-extensions-&-work-sheet))
                      (and ( input-data ?01 ?a)
                           ( controls ?02 ?a)
                           ( out-put data ?03 ?a)))))))))

(and (doc summarise estimate -1
" The occurrence of summarise estimate in the Dec-10 1 schematic")
  (forall ?a
       (=> (activation-of ?a summarise estimate -1)
            (activation-of ?a summarise estimate))))

(forall ?a
  (=> (activation-of ?a summarise estimate -1)
       (exists ?p
            (=> activation-of ?p decomposition-10.1)
            (subactivity-occurrence ?a ?p)))))
(forall ?a
   (=>(activation-of ?a summarise estimate -1)
       (exists ?01
       (exists ?02
       (exists ?03
       (=> (and (instance-of ?01 measured-rates
                        priced-preliminaries
                        build-ups-extensions-&-work-sheets)
                (instance-of ?02 conditions-of-contract)
                (instance-of ?03 completed-estimate))
       (and (input-data ?01 ?a)
            (controls ?02 ?a)
            (out-put data ?03 ?a)))))))))

(and (doc review late quotations -1
   "The occurrence of review late quotations in the Dec-10 1 schematic")
   (and (forall ?a
       (=>(activation-of ?a review late quotations -1)
           (activation-of ?a review late quotations)))
       (forall ?a
       (=>(activation-of ?a review late quotations -1)
           (exists ?p
           (=> activation-of ?p decomposition-10 1)
           (subactivity-occurrence a ?p)))))))))

(foreall ?a
   (=>(activation-of ?a review late quotations -1)
       (exists ?01
       (exists ?02
       (exists ?03
       (=> (and (instance-of ?01 trade-file/late-quotations)
                (instance-of ?02 conditions-of-contract)
                (instance-of ?03 competitive-late-quotations))
       (and (input-data ?01 ?a)
            (controls ?02 ?a)
            (out-put data ?03 ?a))))))))})

(and (doc j1 "JI")
   (and (forall ?j
       (=>(activation-of ?j j1)
           (exists ?p
           (=>(activation-of ?p decomposition 10 1)
               (subactivity-occurrence ?j ?p)))))
       (and follows co-ordinate tender j1 decomposition-10.1)
       (and (and_split j1 decomposition 10.1)
       (and (subactivity price bill of quantities j1)
       (and (subactivity price preliminary schedule j1)))))))))

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(and (doc j2 "J2")
  (and (forall ?j
    (=>(activation-of ?j j2)
      (exists ?p
        (=>(activation-of ?p decomposition 10 1)
          (subactivity-occurrence ?j ?p)))))
    (and (and_split j2 decomposition 10 1)
      (and (subactivity price bill of quantities j2)
        (and (subactivity price preliminary schedule j2)
          (and (subactivity make arithmetic check j2)
            (and (subactivity review late quotations j2)))))))))

(and (doc j3 "J3")
  (and (forall ?j
    (=>(activation-of ?j j3)
      (exists ?p
        (=>(activation-of ?p decomposition 10 1)
          (subactivity-occurrence ?j ?p)))))
    (and (follows j3 summarise estimate decomposition-10 1)
      (and (and_split j3 decomposition 10 1)
        (and (subactivity make arithmetic check j3)
          (and (subactivity review late quotations j3)))))))
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(doc plan & schedule construction operation "Plan & Schedule Construction Operation")

(and (doc schedule construction operation
"The Top Level scheduling construction operation process schematic")
  (and (subactivity schedule construction operation-1 schedule construction operation)
    (idef-process pre-tender procedure)))

(and (doc schedule construction operation-1 "The occurrence of Schedule Construction Operation in the schematic")
  (and (forall ?a
      (=>activation of ?a schedule construction operation-1)
      (activation of ?a schedule construction operation)))

  (forall ?a
    (=>activation of ?a schedule construction operation-1)
    (activation of ?a decomposition-2.1)))

  (and (forall ?a
    (=>activation of ?a schedule construction operation-1)
    (exists ?01
     (exists ?02
      (exists ?03
       (=> (and (instance-of ?01 drawing-document-or-estimating-data)
               (instance-of ?02 production schedule)
               (instance-of ?03 production schedule))
        (and (input-data ?01 ?a)
             (controls ?02 ?a)
             (output-data ?03 ?a))))))))

(and (doc decomposition-2 1 "Decomposition of Schedule Construction Operation")
  (and (subactivity analysis scope -1 decomposition-2.1)
    (and (subactivity identify construction task-1 decomposition-2.1)
      (and (subactivity assign resources to tasks-1 decomposition-2.1)
        (and (subactivity estimate duration-1 decomposition-2.1)
          (and (subactivity define relationship-1 decomposition-2.1)
            (and (subactivity complete schedule-1 decomposition-2.1)
              (and (subactivity J1 decomposition-2.1)
                (and (subactivity J2 decomposition-2.1)
                  (idef-process decomposition-2 1)))))))))

(and (doc analysis scope -1
"The occurrence of analysis scope in the Dec-2 1 schematic")
  (and (forall ?a
    (=> (activation-of ?a analysis scope -1)
      (activation-of ?a analysis scope)))

    (forall ?a
      (=> (activation-of ?a analysis scope -1)
        (exists ?p
         (=> (activation-of ?p decomposition-2.1)
          (subactivity-occurrence ?a ?p)))))))

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(forall ?a
   (=>(activation-of ?a analysis scope -1)
       (exists ?01
            (exists ?02
                 (exists ?03
                  (=> (and (instance-of ?01 project-information)
                         (instance-of ?02 purpose-of-schedule)
                         (instance-of ?03 level-of-detail-required))
                       (and (input-data ?01 ?a)
                            (controls ?02 ?a)
                            (out-put data ?03 ?a))))))

(and (doc identify scheduling-items-1 " The occurrence of identify Scheduling-Items in the Dec-21 schematic")
    (and (forall ?a
        (=> (activation-of ?a identify scheduling-items-1)
            (activation-of ?a identify scheduling-items)))

(foreall ?a
   (=>(activation-of ?a identify scheduling-items-1)
       (exists ?p
        (=> activation-of ?p decomposition-2.1)
        (subactivity-occurrence ?a ?p)))

(foreall ?a
   (=>(activation-of ?a identify scheduling-items-1)
       (activation-of ?a decomposition 5.1))))

(and forall ?a
   (=>(activation-of ?a identify scheduling-items-1)
       (exists ?01
            (exists ?02
                 (exists ?03
                  (=> (and (instance-of ?01 design-document/estimating-data)
                         (instance-of ?02 project information)
                         (instance-of ?03 tasks-resources))
                       (and (input-data ?01 ?a)
                            (controls ?02 ?a)
                            (out-put data ?03 ?a))))))

(and (doc identify-tasks-1 " The occurrence of Identify Tasks in the Dec-2.1 schematic")
    (and (forall ?a
        (=> (activation-of ?a identify-tasks-1)
            (activation-of ?a identify-tasks)))

(foreall ?a
   (=>(activation-of ?a identify-tasks-1)
       (exists ?p
        (=> activation-of ?p decomposition-2.1)
        (subactivity-occurrence ?a ?p))))

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(forall ?a
  (=> (activation-of ?a identify-tasks-1)
      (exists ?01
           (exists ?02
                (exists ?03
                     (=> (and (instance-of ?01 scheduling-elements)
                             (instance-of ?02 ---------------------)
                             (instance-of ?03 shedding-tasks))
                     (and (input-data ?01 ?a)
                          (controls ?02 ?a)
                          (output-data ?03 ?a))))))

(and (doc assign-resources-to-tasks-1
      "The occurrence of Assign Resources to Tasks in the Dec-2 1 schematic")
    (forall ?a
     (=> (activation-of ?a assign-resources-to-tasks-1)
         (activation-of ?a assign-resources-to-tasks)))

(forall ?a
  (=> (activation-of ?a assign-resources-to-tasks-1)
      (exists ?p
           (=> activation-of ?p decomposition-2.1)
           (subactivity-occurence ?a ?p))))

(forall ?a
  (=> (activation-of ?a assign-resources-to-tasks-1)
      (exists ?01
           (exists ?02
                (exists ?03
                     (=> (and (instance-of ?01 scheduling-elements)
                             (instance-of ?02 ---------------------)
                             (instance-of ?03 resources-of-tasks))
                     (and (input-data ?01 ?a)
                          (controls ?02 ?a)
                          (output-data ?03 ?a))))))

(and (doc estimate-duration-of-tasks-1
      "The occurrence of Estimate Duration in the Dec-2 1 schematic")
    (forall ?a
     (=> (activation-of ?a estimate-duration-of-tasks-1)
         (activation-of ?a estimate-duration-of-tasks)))

(forall ?a
  (=> (activation-of ?a estimate-duration-of-tasks-1)
      (exists ?p
           (=> activation-of ?p decomposition-2.1)
           (subactivity-occurence ?a ?p))))
(forall ?a
   (=> (activation-of ?a estimate-duration-of-tasks-1)
        (exists ?01
            (exists ?02
                (exists ?03
                    (=> (and (instance-of ?01 production-task resource-use)
                            (instance-of ?02 resources-use)
                            (instance-of ?03 time-duration))
                        (and (input-data ?01 ?a)
                            (controls ?02 ?a)
                            (output-data ?03 ?a)))))))))

(and (doc define-production-sequences-1 "The occurrence of Define-Production-Sequence in the Dec-2 I schematic")
    (forall ?a
        (=> (activation-of ?a define-production-sequences-1)
            (activation-of ?a define-production-sequences)))

(foreach ?a
    (activation-of ?a define-production-sequences-1)
    (exists ?p
        (activation-of ?p decomposition-2 I)
        (subactivity-occurrence ?a ?p)))

(foreach ?a
    (activation-of ?a define-production-sequences-1)
    (activation-of ?a decomposition 7 I))))))

(and (forall ?a
    (=> (activation-of ?a define-production-sequences-1)
        (activation-of ?a decomposition-2 I)))

(foreach ?a
    (activation-of ?a define-production-sequences-1)
    (exists ?01
        (exists ?02
            (exists ?03
                (=> (and (instance-of ?01 production-tasks)
                            (instance-of ?02 tasks-relationship)
                            (instance-of ?03 production-tasks-sequence))
                        (and (input-data ?01 ?a)
                            (controls ?02 ?a)
                            (output-data ?03 ?a)))))))

(and (doc complete-schedule-1 "The occurrence of complete schedule in the Dec-2 I schematic")
    (forall ?a
        (activation-of ?a complete-schedule-1)
        (activation-of ?a complete-schedule)))

(foreach ?a
    (activation-of ?a complete-schedule-1)
    (exists ?p
        (activation-of ?p decomposition-2.1)
        (subactivity-occurrence ?a ?p)))))))
(forall ?a
    (=>(activation-of ?a complete-schedule-1)
    (exists ?01
    (exists ?02
    (exists ?03
    (=> (and (instance-of ?01 scheduling-tasks
tasks-time-durationrelationship-between-tasks
tasks-dependencycalendar-dates)
    (instance-of ?02 ----------------))
    (instance-of ?03 production-schedule))
    (and (input-data ?01 ?a)
    (controls ?02 ?a)
    (out-put data ?03 ?a))))))

(and (doc J1 "J1")
    (and (forall ?j
    (=>(activation-of ?j j1)
    (exists ?p
    (=>(activation-of ?p decomposition 2 1)
    (subactivity-occurrence ?j ?p))))
    (and (follows scheduling-items j1 decomposition 2 1)
    (and (and_split j1 decomposition 2 1)
    (and (subactivity identify-task j2)
    (and (subactivity assign-resource j2)))))))))

(and (doc J2 "J2")
    (and (forall ?j
    (=>(activation-of ?j j2)
    (exists ?p
    (=>(activation-of ?p decomposition 2 1)
    (subactivity-occurrence ?j ?p))))
    (and (follows j2 identity-scheduling-tasks decomposition-2 1)
    (and (and_split j2 decomposition 2 1)
    (and (subactivity identify-task j2)
    (and (subactivity assign-resource j2)))))))))

(and (doc decomposition-5.1 "Decomposition of Identify Construction Task")
    (and (subactivity analyse-estimating-data-1 decomposition-5 1)
    (and (subactivity aggregate-estimating-tasks-&-resources-1 decomposition-5.1)
    (and (subactivity analyse-design-document-1 decomposition-5 1)
    (and (subactivity identity-tasks-required-to-realise-product-1 decomposition-5 1)
    (and (subactivity identify-resources-required-to-perform-task-1 decomposition-5 1)
    (and (subactivity identity-scheduling-tasks-1 decomposition-5.1)
    (and (subactivity J1 decomposition-5 1)
    (def-process decomposition-5 1))))))))

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(and (doc analyse-estimating-data-I
  "The occurrence of Analyse-Estimating-Data in the Dec-5 Ischematic")
  (and (forall ?a
    (=> (activation-of ?a analyse-estimating-data-I)
     (activation-of ?a analyse-estimating-data)))

    (forall ?a
     (=>(activation-of ?a analyse-estimating-data-I)
      (exists ?p
       (=> activation-of ?p decomposition-5 I)
       (subactivity-occurrence ?a ?p)))))

    (forall ?a
     (=>(activation-of ?a analyse-estimating-data-I)
      (exists ?01
       (exists ?02
       (exists ?03
      (=> (and (instance-of ?01 estimating-document)
             (instance-of ?02 ---------------)
             (instance-of ?03 estimating-data))
      (and (input-data ?01 ?a)
          (controls ?02 ?a)
          (output data ?03 ?a))))))))

(and (doc aggregate-estimating-tasks-&-resources-I
  "The occurrence of Aggregate-Estimating-Tasks-&-Resources in the Dec-5 Ischematic")
  (and (forall ?a
    (=> (activation-of ?a aggregate-estimating-tasks-&-resources-I)
     (activation-of ?a aggregate-estimating-tasks-&-resources)))

    (forall ?a
     (=>(activation-of ?a aggregate-estimating-tasks-&-resources-I)
      (exists ?p
       (=> activation-of ?p decomposition-5 I)
       (subactivity-occurrence ?a ?p)))))

    (forall ?a
     (=>(activation-of ?a aggregate-estimating-tasks-&-resources-I)
      (exists ?01
       (exists ?02
       (exists ?03
      (=> (and (instance-of ?01 estimating-data)
             (instance-of ?02 ---------------)
             (instance-of ?03 aggregated-tasks-&-resources))
      (and (input-data ?01 ?a)
          (controls ?02 ?a)
          (output data ?03 ?a))))))))
(and (doc analyse-design-document -1
  "The occurrence of Analyse-Design-Document in the Dec-5 Ischematic")
  (and (forall ?a
    (=> (activation-of ?a analyse-design-document-1)
      (activation-of ?a analyse-design-document-1)))
    (forall ?a
      (=> (activation-of ?a analyse-design-document-1)
        (exists ?p
          (=> activation-of ?p decomposition-5 1)
          (subactivity-occurence ?a ?p))))))

(forall ?a
  (=> (activation-of ?a analyse-design-document-1)
    (exists ?01
      (exists ?02
        (exists ?03
          (=> (and (instance-of ?01 design-document)
                    (instance-of ?02 ---------------)
                    (instance-of ?03 product-design-data))
            (and (input-data ?01 ?a)
              (controls ?02 ?a)
              (output-data ?03 ?a)))))
    (forall ?a
      (=> (activation-of ?a identify-tasks-required-to-realise-product-1)
        (exists ?01
          (exists ?02
            (exists ?03
              (=> (and (instance-of ?01 product-data)
                        (instance-of ?02 ---------------)
                        (instance-of ?03 tasks))
                  (and (input-data ?01 ?a)
                    (controls ?02 ?a)
                    (output-data ?03 ?a))))))))))
(and (doc identify-resources-required-to-perform-task-1
   "The occurrence of Identify-Resources-Required-to-Perform-Task in the Dec-5 Ischematic"
   (and (forall ?a
         (=> (activation-of ?a identify-resources-required-to-perform-task-1)
             (activation-of ?a identify-resources-required-to-perform-task))))

   (forall ?a
    (=> (activation-of ?a identify-resources-required-to-perform-task-1)
        (exists ?p
         (=> activation-of ?p decomposition-5-1
             (subactivity-occurrence ?a ?p))))))

   (forall ?a
    (=> (activation-of ?a identify-resources-required-to-perform-task-1)
        (exists ?01
            (exists ?02
                (exists ?03
                 (=> (and (instance-of ?01 tasks-&-product)
                        (instance-of ?02 ---------------)
                        (instance-of ?03 resources))
                 (and (input-data ?01 ?a)
                      (controls ?02 ?a)
                      (output-data ?03 ?a))))))))

(and (doc identify-scheduling-tasks-1
   "The occurrence of Identify-Scheduling-Tasks in the Dec-5 Ischematic"
   (and (forall ?a
         (=> (activation-of ?a identify-scheduling-tasks-1)
             (activation-of ?a identify-scheduling-tasks)))

   (forall ?a
    (=> (activation-of ?a identify-scheduling-tasks-1)
        (exists ?01
            (exists ?02
                (exists ?03
                 (=> (and (instance-of ?01 aggregated-estimating-data-or-tasks-&-resources-of-product)
                        (instance-of ?02 ---------------)
                        (instance-of ?03 scheduling-tasks-&-resources))
                 (and (input-data ?01 ?a)
                      (controls ?02 ?a)
                      (output-data ?03 ?a))))))))

(and (doc j1 "J1")
    (and (forall ?j
         (=> (activation-of ?j j1)
             (exists ?p
              (=> (activation-of ?p decomposition 5-1)
                  (subactivity-occurrence ?j ?p))))
              (and (xor_split j1 decomposition 5-1)
                   (and (subactivity analyse-estimating-data j1)
                        (and (subactivity analyse-design-document j1))))))

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(and (doc j2 "J2")
  (and (forall ?j
    (=>(activation-of ?j j2)
        (exists ?p
         (=>(activation-of ?p decomposition 5 1)
             (subactivity-occurrence ?j ?p)))))
    (and (follows j2 identity-scheduling-tasks decomposition-5 1)
         (and (xor_split j2 decomposition 5 1)
              (and (subactivity aggregate-estimating-tasks-&-resources j2)
                   (and (subactivity identify-resources-required-to-perform-tasks j2)))))
  )))

(and (doc decomposition-9 1 "Decomposition of define construction sequence")
  (and (subactivity select-task -1 decomposition-8 1)
    (and (subactivity define-predecessor-task-1 decomposition-8 1)
         (and (subactivity define-relation-between-tasks-1 decomposition-8 1)
              (idef-process decomposition-8 1))))))

(and (doc select task -1
  " The occurrence of Select Task in the Dec-8. schematic")
  (and (forall ?a
    (=> (activation-of ?a select task -1)
        (activation-of ?a select task)))
    (forall ?a
     (=>(activation-of ?a select task -1)
         (exists ?p
          (=> activation-of ?p decomposition-8 1)
          (subactivity-occurence ?a ?p))))
    (forall ?a
     (=>(activation-of ?a select task -1)
         (exists ?01
          (exists ?02
           (exists ?03
            (=> (and instance-of ?01 scheduling-items)
                (instance-of ?02 ---------------)
                (instance-of ?03 task))
              (and (input-data ?01 ?a)
                   (controls ?02 ?a)
                   (output-data ?03 ?a)))))))))))

(and (doc define predecessor -1
  " The occurrence of Define Predecessor in the Dec-8.1 schematic")
  (and (forall ?a
    (=> (activation-of ?a define predecessor -1)
        (activation-of ?a define predecessor)))
    (forall ?a
     (=>(activation-of ?a define predecessor -1)
         (exists ?p
          (=> activation-of ?p decomposition-8 1)
          (subactivity-occurrence ?a ?p)))))))

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(forall ?a
  (=> (activation-of ?a define predecessor -I)
      (exists ?01
       (exists ?02
        (exists ?03
         (=> (and (instance-of ?01 scheduling-items)
                (instance-of ?02 -------------)
                (instance-of ?03 predecessor-task))
              (and (input-data ?01 ?a)
                   (controls ?02 ?a)
                   (output data ?03 ?a))))))))

(and (doc define relation -1
      "The occurrence of Define Relation in the Dec-8.Ischematic")
      (forall ?a
       (=> (activation-of ?a define relation -1)
           (activation-of ?a define relation))
       (forall ?a
        (=> (activation-of ?a define relation -1)
            (exists ?p
             (=> (activation-of ?p decomposition-8 1)
                 (subactivity-occurrence ?a ?p)))))))

(foreall ?a
  (=> (activation-of ?a define relation -1)
      (exists ?01
       (exists ?02
        (exists ?03
         (=> (and (instance-of ?01 scheduling-items)
                 (instance-of ?02 -------------)
                 (instance-of ?03 tasks-dependency))
              (and (input-data ?01 ?a)
                   (controls ?02 ?a)
                   (output data ?03 ?a))))))))
Appendix E

Drawing Representations of the Case Study Project

Detailed drawing of the Metal door 530