The University of Sheffield

Department of Civil & Structural Engineering

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PhD Research: Numerical Modelling of Contract Strategy Evaluation

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I am a PhD research student at The University of Sheffield. The research is an investigation into contract strategy selection. This document outlines an exercise related to this subject. I would be very grateful if you could read this document and attempt the exercise.

The aim of the exercise is to examine whether it is possible at the beginning of a particular construction project to estimate, in units of cost and time, the effects that different contract strategies are likely to have on the project's price and duration.

You are presented with a summary of the feasibility study for a hypothetical project. You are asked to take the role of the client's cost consultant. You are asked to assume that a junior estimator has used the results of the feasibility study to estimate the main cost and time elements of the project based upon the assumption that the project is to be procured using a Traditional contract strategy.

The exercise asks you to:

1. adjust the junior estimator's estimates for the Traditional contract strategy if you consider that they should be different;
2. assume the project is to be procured using a Design-Build and make new estimates of the project's main cost and time elements;
3. assume the project is to be procured using a Management Contracting contract strategy and make new estimates of the project's main cost and time elements.

In order to make the estimates you may need to make some assumptions about the project and its circumstances, possibly including some assumptions about the capabilities of the client and of the potential parties who could be employed under certain contract strategies. You will need to apply your own experiences to the hypothetical project scenario. I would prefer to collect and discuss these details of your estimating process as well as your actual estimates. If it is possible for us to meet do not hesitate to contact me (see top of sheet for my address and phone number). This discussion could take place during or after your attempt at the exercise. However, if you are unable to meet to discuss this aspect of the exercise please could you still attempt the exercise as your estimates will be of great value to the research.

Project scenario:

A relatively new insurance company wishes to build a new headquarters. The company has had very little construction experience and has no in-house resources to assist in administering the project. The company is deciding whether or not to build on a prospective site. The company has employed a team of consultants to perform a feasibility study for a fee of £15,000. The study included an investigation of the ground and site characteristics and some preliminary design was undertaken. The main items of the feasibility report are summarised below.

Project description:

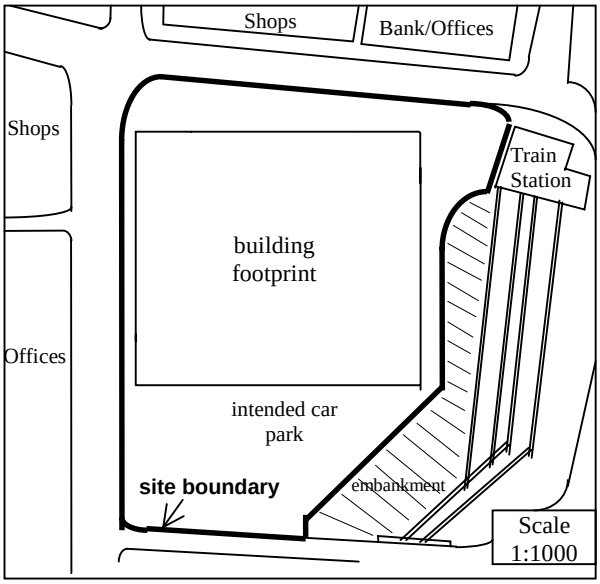
The project is a 7-storey reinforced concrete framed office block which will provide a gross floor area of 10,000m^2 (9000m^2 of office space). The building must provide office space for 1300 people. The overall project cost is estimated at £8 million and project duration of 21 months.

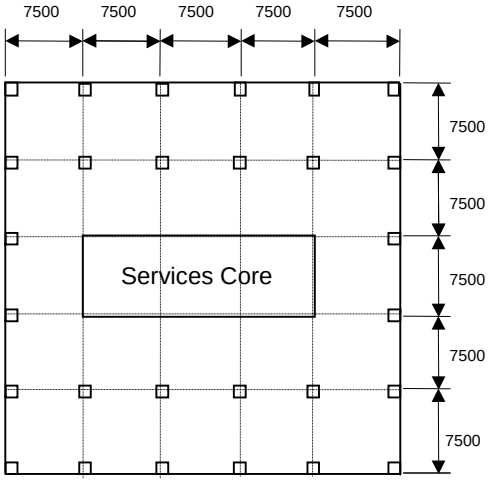
The soils on the site are mainly clay with some sand mixed in. The soil is relatively strong and its bearing capacity is estimated at 200kN/m^2.

The site was previously occupied by a cinema which has since been demolished and cleared. The site is located on the outskirts of a city centre. The adjacent buildings could impose some construction restrictions and traffic congestion on the surrounding road infrastructure is not uncommon (see **Site Plan** on page 2).

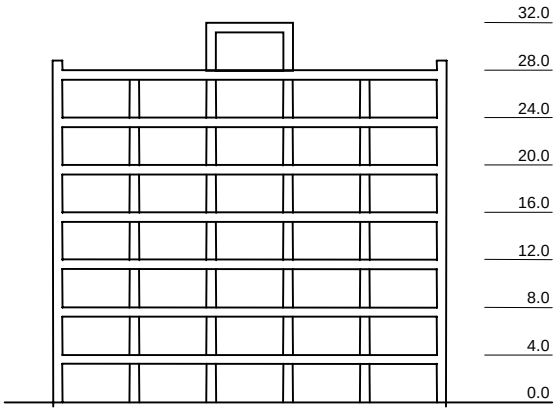
The main aspects of the preliminary design are outlined in Table 1 and the sketches on page 2.

Site Plan





Typical Floor Plan



Typical Elevation

Table 1 The main preliminary design proposals

Substructure	1m thick pad foundations set at 2.5m below ground level 200mm thick ground bearing slab
Superstructure	300mm concrete flat slab to all upper floors except roof slabs which are 350mm thick 700mm square columns cover a 7.5m x 7.5m structural grid 200mm thick curtain wall cladding with floor to ceiling glazing
Internal Finishes	granite or terrazzo on screed floors in entrance hall and lift lobbies raised floor system and carpet in office areas metal tiled ceiling with concealed suspension system emulsion painted walls
Fittings	offices entrance hall service cores
Services	air conditioning gas-fired boiler in roof plant room (low temp, hot water radiant panels) vents incorporated in light fitting 3 passenger lifts, 2 fire lifts
External Works	car park drainage, water and gas connections

I would like you to assume the role of the insurance company's cost consultant. It is your responsibility to advise the company which contract strategy to select for the 7-storey office project. Assume that you are considering the following 3 contract strategy options:

1. **Traditional:** a team of design consultants complete the design and administer the project. The design is complete before the construction is let to a general contractor using a negotiated tender process. The client's detailed bill of quantities is used to negotiate a Guaranteed Maximum Price (any cost savings are shared equally) and it also provides a basis for re-measurement of the price.
2. **Design-Build:** the remainder of the design and the entire construction work is let as a single package using a competitive one-stage tender process. The package is let on the basis of a fixed lump sum price.
3. **Management Contract:** a management contractor is appointed during the conceptual design stage following a pre-qualification process and negotiation of the management contractor's fees. The pre-construction fee is a lump sum, while the fee for services during construction is based on a target cost arrangement where the management contractor receives a percentage value of the construction cost, but any cost savings or overruns relative to a negotiated target cost are shared equally between the client and management contractor. The management contractor divides the construction into work packages and each package is tendered competitively on the basis of a cost plus percentage fee payment mechanism. The management contractor administers the tender process for each work package.

Assume that the junior estimator has already considered the **Traditional** contract strategy and made the series of cost and time estimates that are shown on page 4. These cost and time estimates include:

1. the client's costs to have the design work completed and the duration of this design process.
2. the client's costs related to the tender process and the duration of the tender process.
3. the client's costs involved in measuring, monitoring and agreeing the price of work (i.e. Transaction costs).
4. the cost and duration of the main construction elements (note: **cost to the contractor**; do not include the contractor's mark-up).
5. the schedule of the main project activities.

All the estimates described in points 1 to 4 are estimated in terms of a minimum, maximum and most likely value. This means that each cost and time element is estimated as a triangular probability distribution with the purpose of incorporating all the uncertainties associated with each cost and time element.

The exercise tasks that I would like you to carry out:

1. Adjust the junior estimator's estimates for the **Traditional** contract strategy if you consider that they should be different;
2. Assume the project is to be procured using a **Design-Build** contract strategy and make new estimates of the project's main cost and time elements;
3. Assume the project is to be procured using a **Management Contracting** contract strategy and make new estimates of the project's main cost and time elements;
4. On the basis of the *total construction cost* for the **Traditional** contract strategy, estimate a minimum, most likely and maximum guaranteed maximum price (GMP);
5. On the basis of the *total design and construction cost* for the **Design-Build** contract strategy, estimate a minimum, most likely and maximum fixed lump sum price;
6. On the basis of the *total construction cost* for the **Management Contracting** contract strategy, estimate a minimum, most likely and maximum management contractor's fee and trade contractors' average percentage fee;
7. Draw a schedule of the main project activities for the **Traditional** contract strategy;
8. Draw a schedule of the main project activities for the **Design-Build** contract strategy;
9. Draw a schedule of the main project activities for the **Management Contracting** contract strategy.

The ***junior estimator*** estimates for the **Traditional (GMP, re-measure)** contract strategy

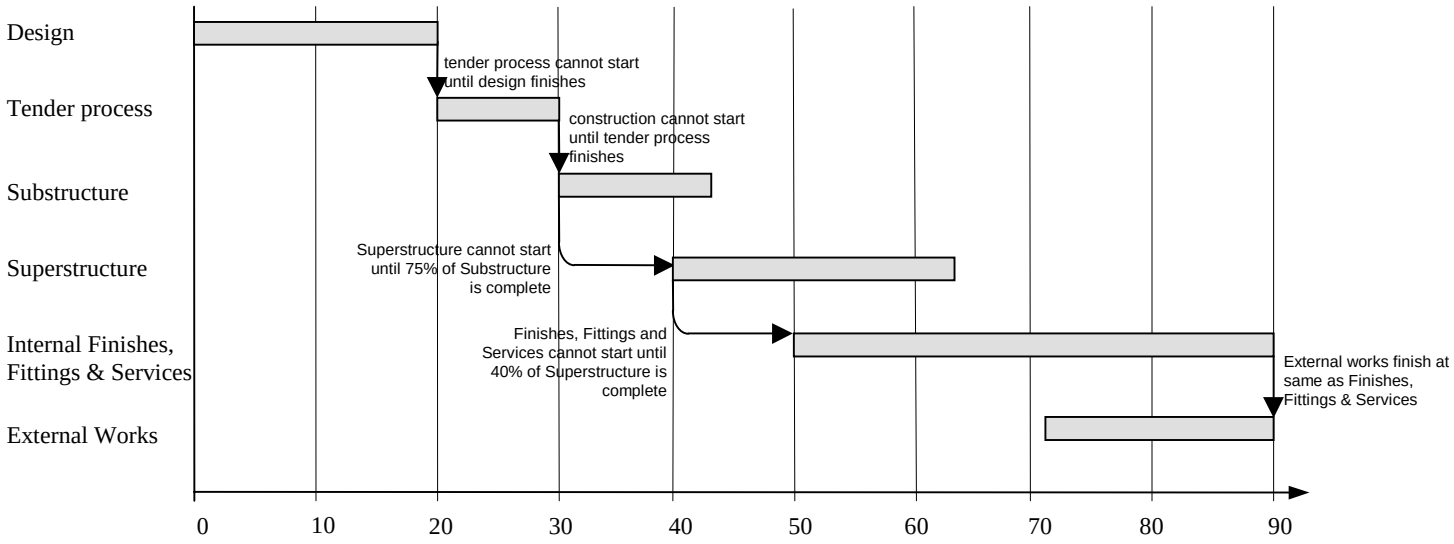
Project Element	COST ESTIMATE (£k)			TIME ESTIMATE (weeks)		
	Min.	*Most likely*	*Max.*	*Min.*	*Most likely*	*Max.*
Design (remaining design)	700	750	850	18	20	23
Tender process	5	7	9	8	10	12
Transaction costs	150	170	225	N/A	N/A	N/A

Construction Element	COST ESTIMATE (£k)			TIME ESTIMATE (weeks)		
	Min.	*Most likely*	*Max.*	*Min.*	*Most likely*	*Max.*
Substructure	150	160	200	12	13	18
Superstructure	2500	2700	3000	20	23	27
Internal Finishes, Fittings and Services	3500	3750	3925	35	40	50
External works	350	400	475	16	18	21

	Min.	*Most likely*	*Max.*
Total construction cost	£6.500 M*	£7.010 M*	£7.600 M*
Total construction time		60 weeks	

*Summation of the construction cost estimates in table above

Project Schedule (note: the duration of the activities are taken as the ***most likely*** duration estimates)



How to display your cost and time estimates

The aim of the exercise is to investigate whether you are able to estimate, in units of cost and time, the effects that 3 different contract strategies are likely to have on the 7-storey office project's price and duration.

The 3 contract strategies are:

1. **Traditional** (negotiated tender, GMP, re-measure)
2. **Design-Build** (competitive 1-stage tender, fixed lump sum price)
3. **Management Contracting** (negotiated target fee with management contractor, cost plus % fee with trade contractors)

(Each contract strategy is described in more detail on page 3.)

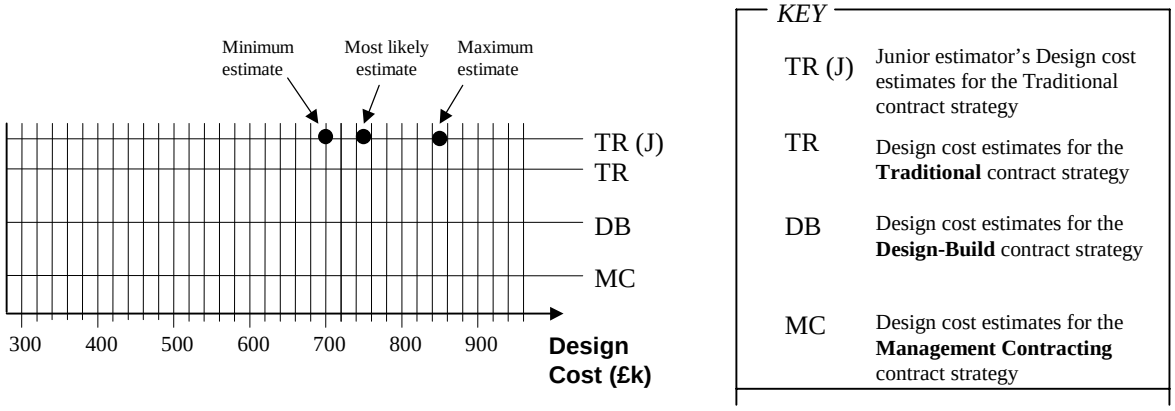
For each contract strategy you are asked to estimate a minimum, most likely and maximum value of the:

- design cost and duration
- tender process cost and duration
- transaction costs
- substructure cost and duration
- superstructure cost and duration
- finishes, fittings and services total cost and duration
- external works cost and duration

You are asked to display your estimates using a special method. This method is designed to assist you to compare and contrast your estimates of each cost and time element between the 3 contract strategies.

This method is demonstrated below using **Design cost** as the example cost element.
(Please note this method is much easier than it may initially appear.)

An example of the type of chart on which you must display your estimates for each cost and time element

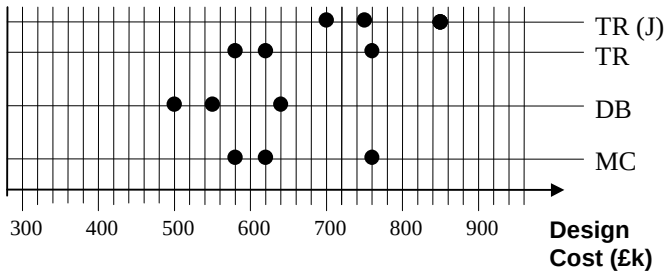


The above chart has a cost scale. The 3 black marks on the chart use the cost scale to represent the junior estimator's minimum, most likely and maximum estimates of the **Design cost**.
These black marks lie along the horizontal line labelled TR(J) which in the KEY is defined as the junior estimator's estimates for the **Traditional** contract strategy.

In this example you would be asked to complete the chart by:

1. Displaying your minimum, most likely and maximum **Design cost** estimates for the **Traditional** contract strategy on the horizontal line labelled TR (if you consider the junior estimator's estimates for the **Traditional** contract strategy are incorrect).
2. Displaying your minimum, most likely and maximum **Design cost** estimates for the **Design-Build** contract strategy on the horizontal line labelled DB.
3. Displaying your minimum, most likely and maximum **Design cost** estimates for the **Management Contracting** contract strategy on the horizontal line labelled MC.

The example chart completed



Cost and Time Estimates for all 3 Contract Strategy Options

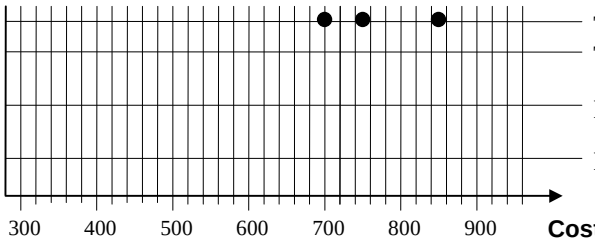
Use the method described on the previous page to display your estimates.
Charts for all the cost and time elements are provided on these next 3 pages (pages 6 - 8).
Please make a note of your assumptions and reasons for your estimates beside your estimates on the right hand side of the appropriate chart. I would like you to explain these assumptions and reasons in more detail during our discussion.

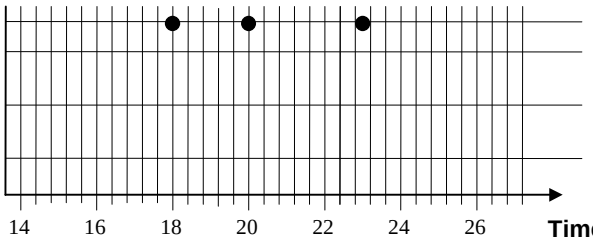
KEY			
TR (J)	Junior estimator's Design cost estimates for the Traditional contract strategy	DB	Design cost estimates for the **Design-Build** contract strategy
TR	Design cost estimates for the **Traditional** contract strategy	MC	Design cost estimates for the **Management Contracting** contract strategy

If an estimate is outside the cost or time range shown on the appropriate chart please write the estimate next to the chart.

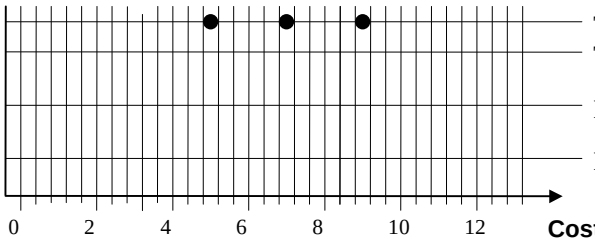
Please make a note of your assumptions and reasons for your estimates on this side of the page

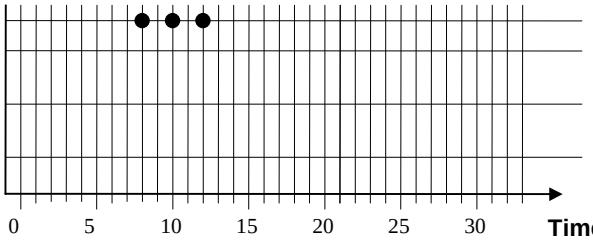
Design



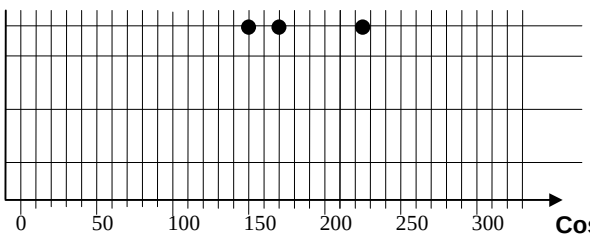


Tender process





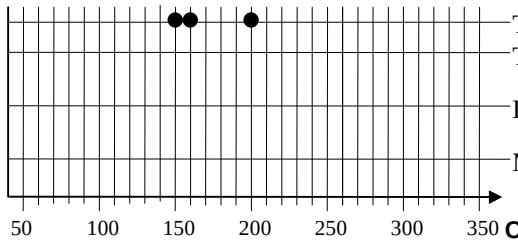
Transaction costs

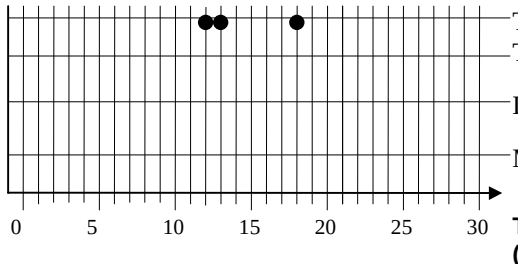


If an estimate is outside the cost or time range shown on the appropriate chart please write the estimate next to the chart.

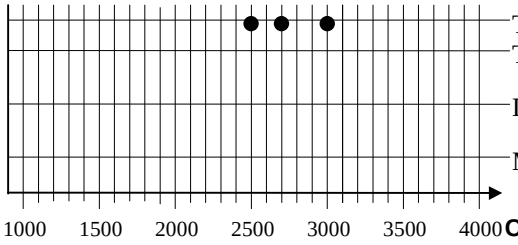
Please make a note of your assumptions and reasons for your estimates

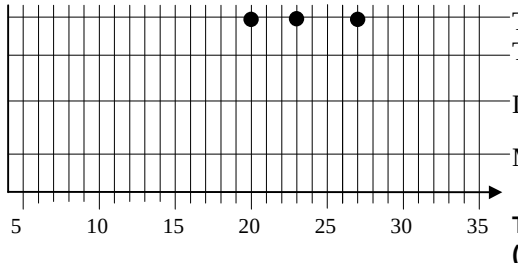
Substructure



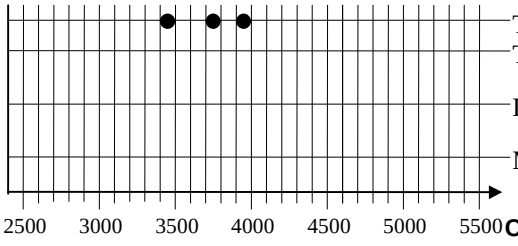


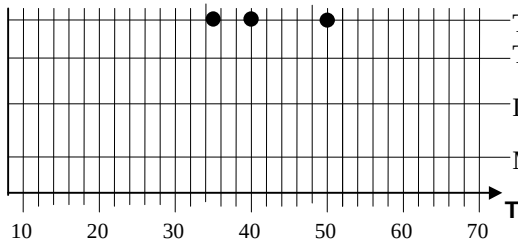
Superstructure





Services, Internal Finishes and Fittings

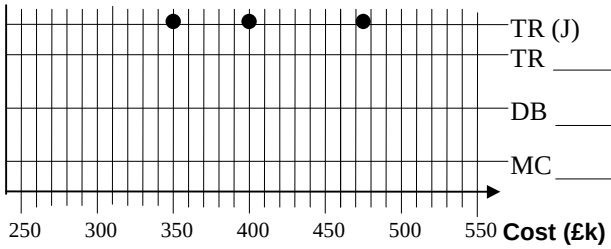


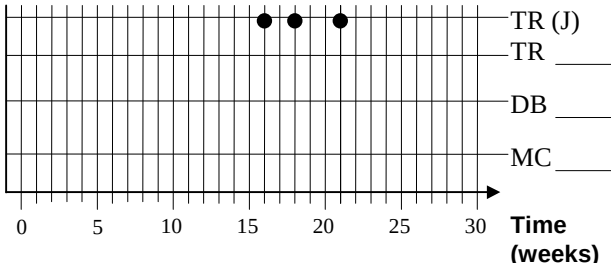


If an estimate is outside the cost or time range shown on the appropriate chart please write the estimate next to the chart.

Please make a note of your assumptions and reasons for your estimates

External Works





Estimates of the Contractor's Mark-up for each of the 3 Contract Strategy Options

Traditional

Pricing element	*Min.*	*Most likely*	*Max.*
Total construction cost	*	*	*
Guaranteed Max. Price			

*Summation of the construction cost estimates for the **Traditional** contract strategy

Design-Build

Pricing element	*Min.*	*Most likely*	*Max.*
Total design and construction cost	*	*	*
Fixed Lump Sum Price			

* Summation of the design and all of the construction cost estimates for the **Design-Build** contract strategy

Management Contract

Pricing element	*Min.*	*Most likely*	*Max.*
Management contractor's pre-construction lump sum fee			
Total construction cost	*	*	*
Management contractor's fee (% of construction costs)			
Target construction cost value negotiated between client and contractor			
Average trade contractors' % fee			

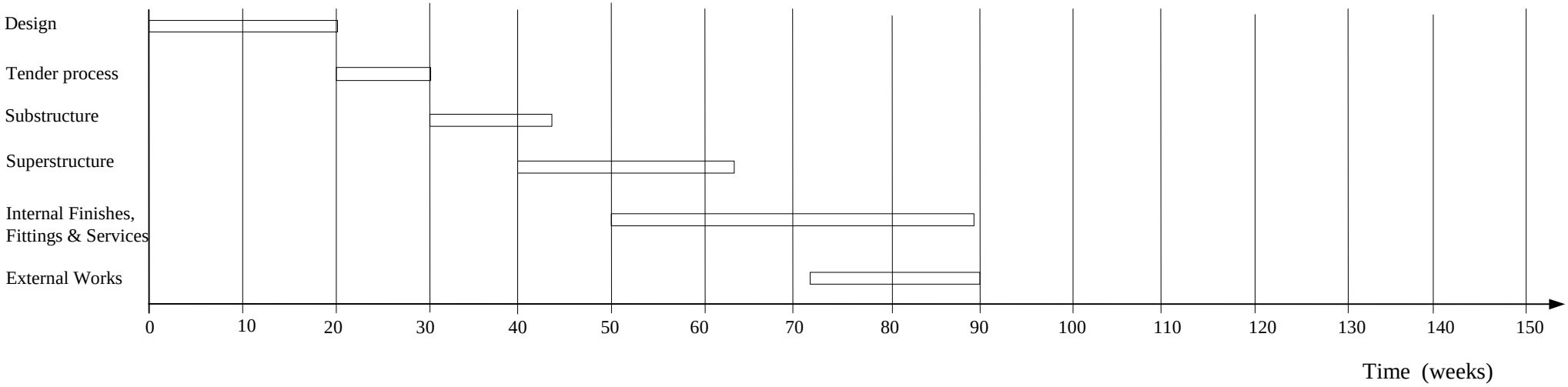
*Summation of the construction cost estimates for the **Management Contracting** contract strategy

Project Schedule

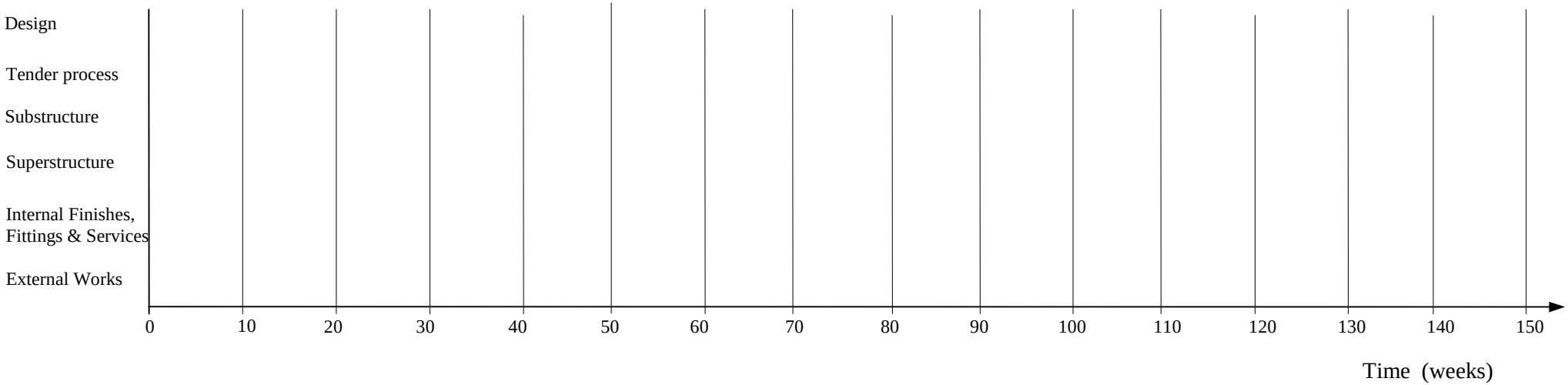
Please estimate a schedule of the main project activities for each of the 3 contract strategy options.

Note: use the ***most likely*** duration estimates as the duration of the activities

Traditional (the junior estimator's estimate of the project schedule for the Traditional contract strategy is shown on the chart below)



Design-Build



Management Contracting