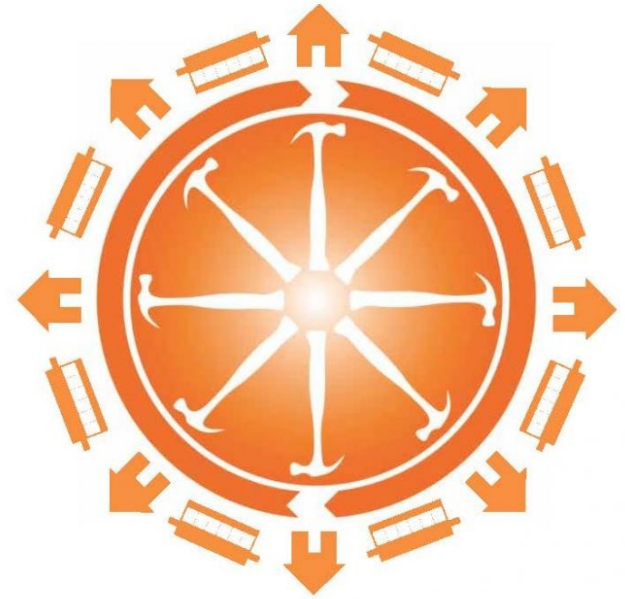


Investigation and Strengthening of Reinforced Concrete Buildings

Cost and Retrofitting

-Construction Management-

- Cost analysis
- Project analysis
- Project cost management
- Retrofitting cost
- Quantity take off and Bill of Quantities (BOQ)



Cost Analysis

- Cost analysis can be basically defined as the detailed analysis of all cost generating components of a product or service.
- Use of statistical methods is the most common approach.
- All factors affecting total cost, dependencies between resources and their variations in time are always analysed and monitored to reduce the overall cost or find out/control mark ups in the projects.

Cost Analysis

- Cost analysis has an important role in projects related to
 - Pricing a product or project
 - Procurement decisions
 - Research and development activities
 - Determining the right marketing tools and media
 - Deciding about a new investment
 - Project development
 - ...

Cost Analysis

- Cost analysis includes
 - Evaluation of estimations
 - Establishing a database of costs
 - Evaluation of project costs
 - Estimating for decision makers
- Cost estimation, which consists of cost assessment of a project or service, is actually one of the outcomes of cost analysis.
- In general, the process of cost analysis is a series of operations that is included from the conceptual development of a project or system until its final use stage.

Fundamental concepts of cost analysis

1. Resource Planning

- Identification of project concept
- Work breakdown, structure
- Preparation of work plans

Fundamental concepts of cost analysis

2. Cost estimation:

- Cost estimation for project activities
- Project budgeting,
- Establishing cost baseline

Fundamental concepts of cost analysis

3. Cost control :

- Performance reports
- Monitoring and control of project costs

Project analysis

- Projects consume the limited resources in the economic environment.
- Selecting a specific project over others means putting other projects on hold or totally giving up on them.
- Deciding on an investment by selecting among alternative projects can be called as project analysis.

Project analysis

- Project analysis basically compare the resources (cost wise) used in the projects over the benefits obtained out of these projects.
- Decision in the investment of the project with the maximum net benefit is expected at the end of this process.
- Technical, commercial, financial, social and environmental factors are investigated in this process.
- Resources should be efficiently and effectively used based on project's expected performance.
- An effective analysis process contributes a lot to performance of the project.

Project analysis

At the end of “project analysis”,

- Value of the product or service
- Calculation of Benefit/ Costanalysis and profitability
- Discount rate and cash flows of the project
- Net present value of the project
- Calculation of risks
- Decision making based on all these outcomes

Project Cost

- Project cost refers to total investment amount, which is calculated carefully prior to investment decision.
- These calculations are particularly important for the profitability of the project. If they are not analyzed critically, then the profitability expected at the end of the project would decrease or may diminish at all.
- The project manager is responsible from the first stage of the project and onward. All calculations should be precise and realistic in order to achieve project budget.

Project cost items in general

- Land cost
- Feasibility studies, project costs
- Technical costs and licence/permit costs
- Land preparation costs
- Mobilization costs
- Construction costs,
- Logistics costs
- Machine and equipment costs
- Insurance costs
- Import and customs costs of several materials, machines and equipments etc..
- Tax payments
- Overhead costs
- Commissioning costs
- Unexpected costs
- Financing costs
-

Project Cost Management

Project Cost Management processes are:

- **Plan Cost Management**—The process of defining how the project costs will be estimated, budgeted, managed, monitored, and controlled.
- **Estimate Costs**—The process of developing an approximation of the monetary resources needed to complete project work.
- **Determine Budget**—The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.
- **Control Costs**—The process of monitoring the status of the project to update the project costs and manage changes to the cost baseline.

7.1 Plan Cost Management

- .1 Inputs
 - .1 Project charter
 - .2 Project management plan
 - .3 Enterprise environmental factors
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data analysis
 - .3 Meetings
- .3 Outputs
 - .1 Cost management plan

7.2 Estimate Costs

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Enterprise environmental factors
 - .4 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Analogous estimating
 - .3 Parametric estimating
 - .4 Bottom-up estimating
 - .5 Three-point estimating
 - .6 Data analysis
 - .7 Project management information system
 - .8 Decision making
- .3 Outputs
 - .1 Cost estimates
 - .2 Basis of estimates
 - .3 Project documents updates

7.3 Determine Budget

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Business documents
 - .4 Agreements
 - .5 Enterprise environmental factors
 - .6 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Cost aggregation
 - .3 Data analysis
 - .4 Historical information review
 - .5 Funding limit reconciliation
 - .6 Financing
- .3 Outputs
 - .1 Cost baseline
 - .2 Project funding requirements
 - .3 Project documents updates

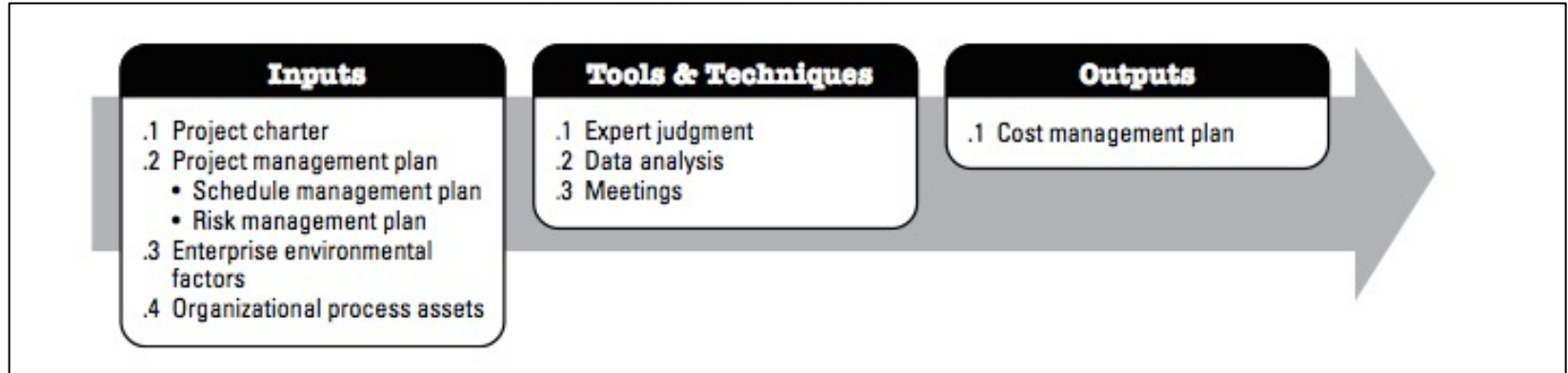
7.4 Control Costs

- .1 Inputs
 - .1 Project management plan
 - .2 Project documents
 - .3 Project funding requirements
 - .4 Work performance data
 - .5 Organizational process assets
- .2 Tools & Techniques
 - .1 Expert judgment
 - .2 Data analysis
 - .3 To-complete performance index
 - .4 Project management information system
- .3 Outputs
 - .1 Work performance information
 - .2 Cost forecasts
 - .3 Change requests
 - .4 Project management plan updates
 - .5 Project documents updates

Plan cost management

- **Plan Cost Management** is the process of defining how the project costs will be estimated, budgeted, managed, monitored, and controlled.
- The key benefit of this process is that it provides guidance and direction on how the project costs will be managed throughout the project.
- This process is performed once or at predefined points in the project.

Plan cost management

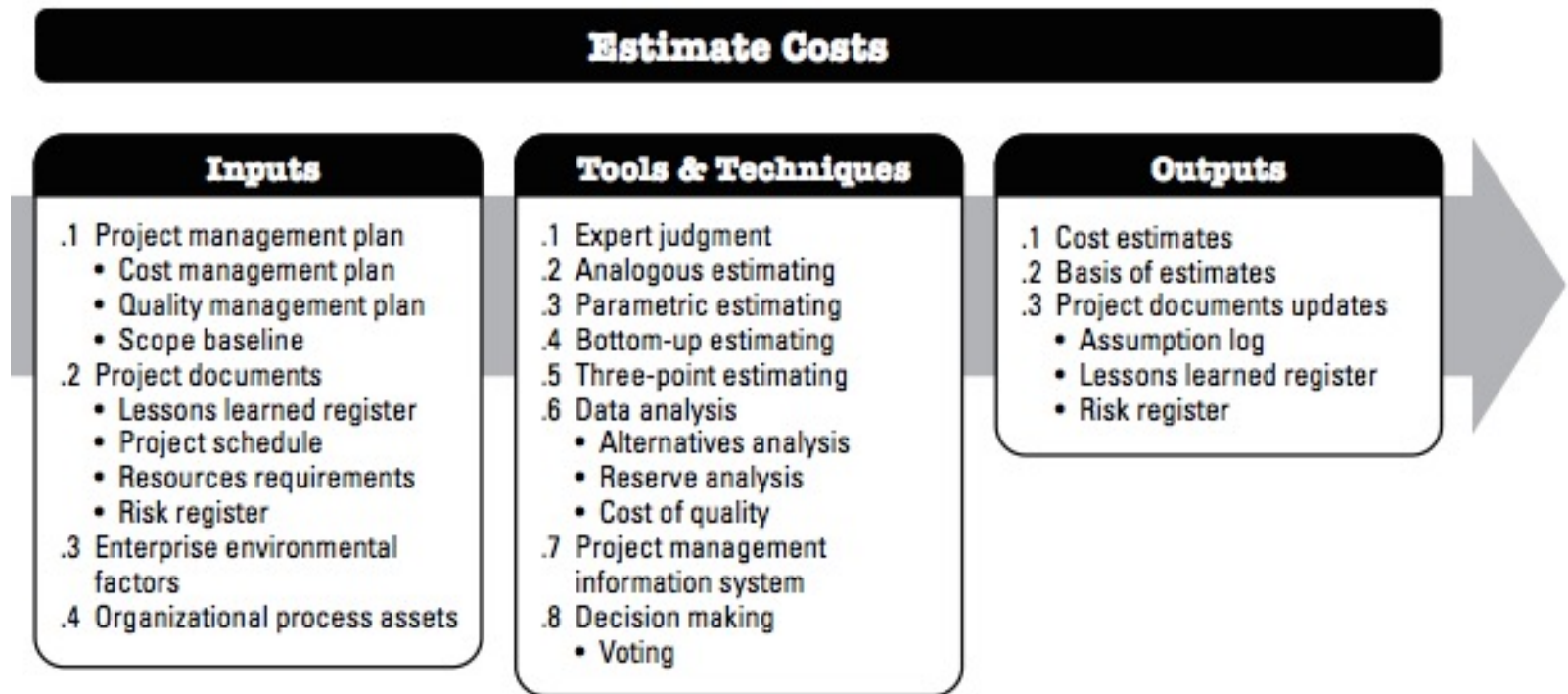


Plan Cost Management: Inputs, Tools & Techniques and Outputs

Estimate costs

- **Estimate Costs** is the process of developing an approximation of the cost of resources needed to complete project work.
- The key benefit of this process is that it determines the monetary resources required for the project.
- This process is performed periodically throughout the project as needed.

Estimate costs

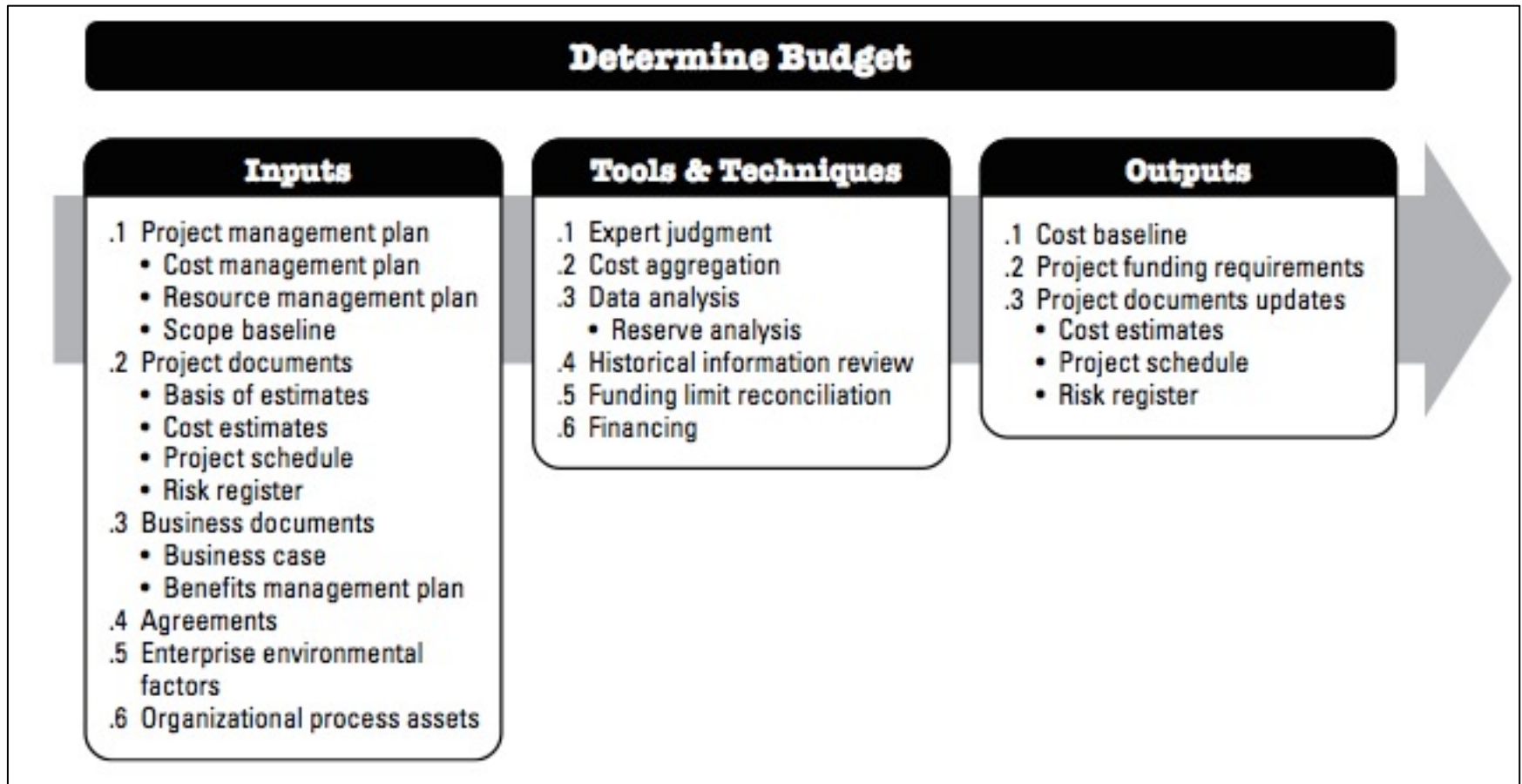


Estimate Costs: Inputs, Tools & Techniques and Outputs

Determine budget

- **Determine Budget** is the process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.
- The key benefit of this process is that it determines the cost baseline against which project performance can be monitored and controlled.
- This process is performed once or at predefined points in the project.
- A project budget includes all the funds authorized to execute the project.

Determine budget

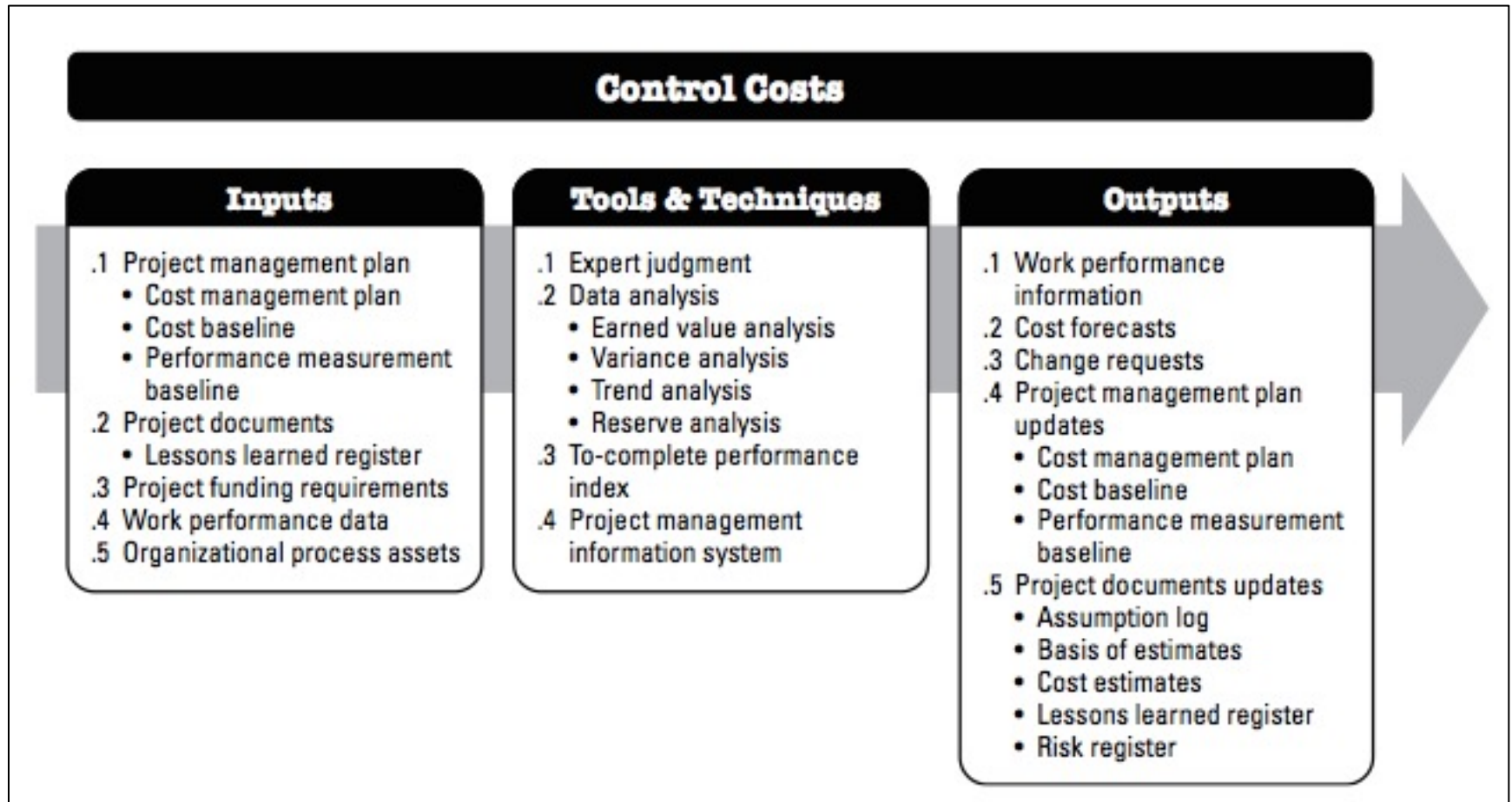


Determine budget: Inputs, Tools & Techniques and Outputs

Control costs

- **Control Costs** is the process of monitoring the status of the project to update the project costs and managing changes to the cost baseline.
- The key benefit of this process is that the cost baseline is maintained throughout the project.
- This process is performed throughout the project.

Control costs



Control costs: Inputs, Tools & Techniques and Outputs

Retrofitting Costs

- Preparation of retrofit projects
- Preparation of plans
- Quantity take offs calculated
- Calculation of costs based on unit prices obtained from Ministry of Environment and Urbanisation
- Constructability checks based on building
- Estimation of building present value
- Decision for rebuilding vs. retrofitting

Planning and Cost estimation

Planning of construction project aims to answer 4 questions:

1. What will be done? (activity=items of work)
2. How will activities be done? (methods)
3. Who will do all activity and which means? (sources)
4. When will activities be done? (sequencing and scheduling)

Planning and Cost estimation

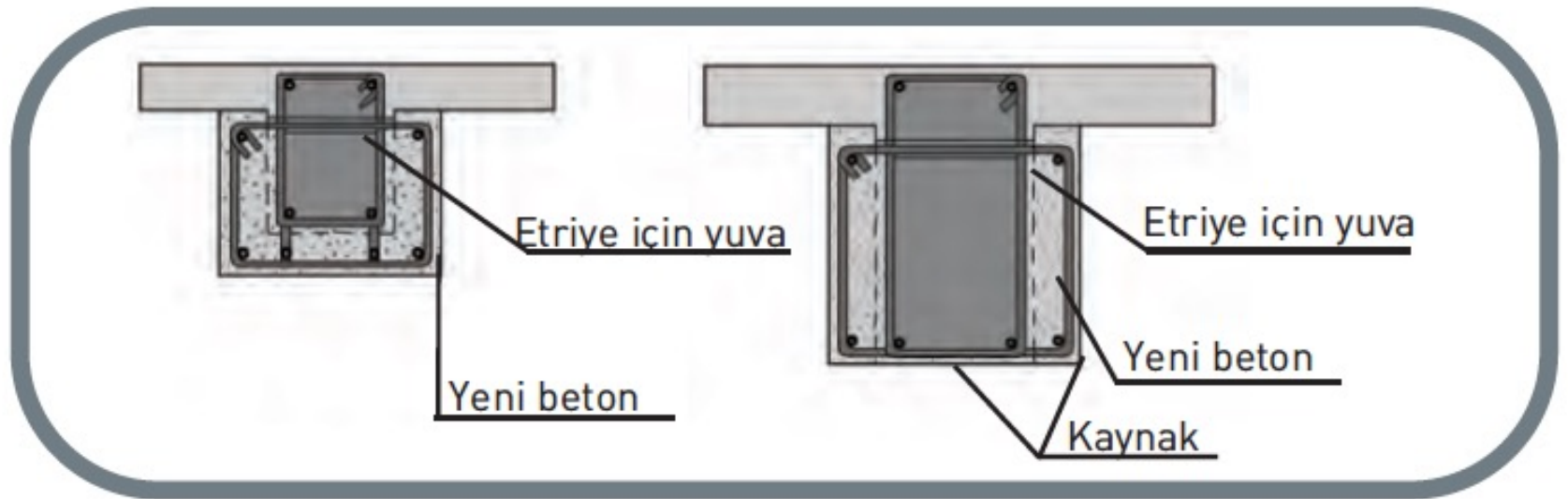
1. What will be done? (activity=items of work)
2. How will activities be done? (methods: which retrofitting methods?)

ALT 1. Retrofitting by RC jacketing

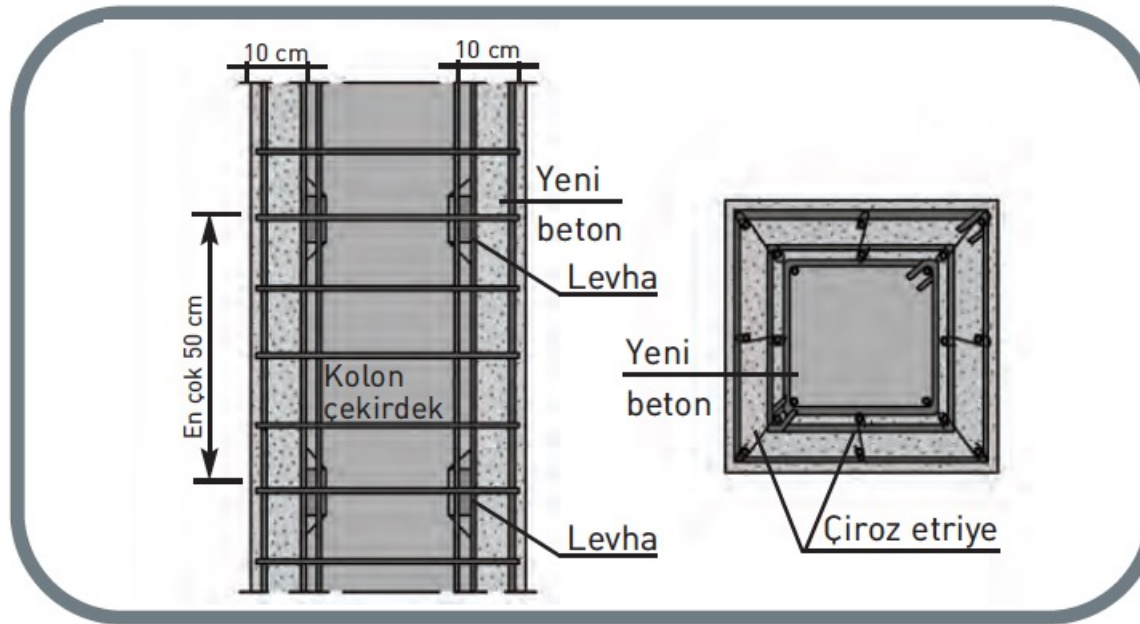
ALT 2. Using Carbon Reinforced polymers

ALT 3. Retrofitting by adding RC shear walls

Retrofitting by RC jacketing - beam



Retrofitting by RC jacketing - column



Carbon reinforced fiber



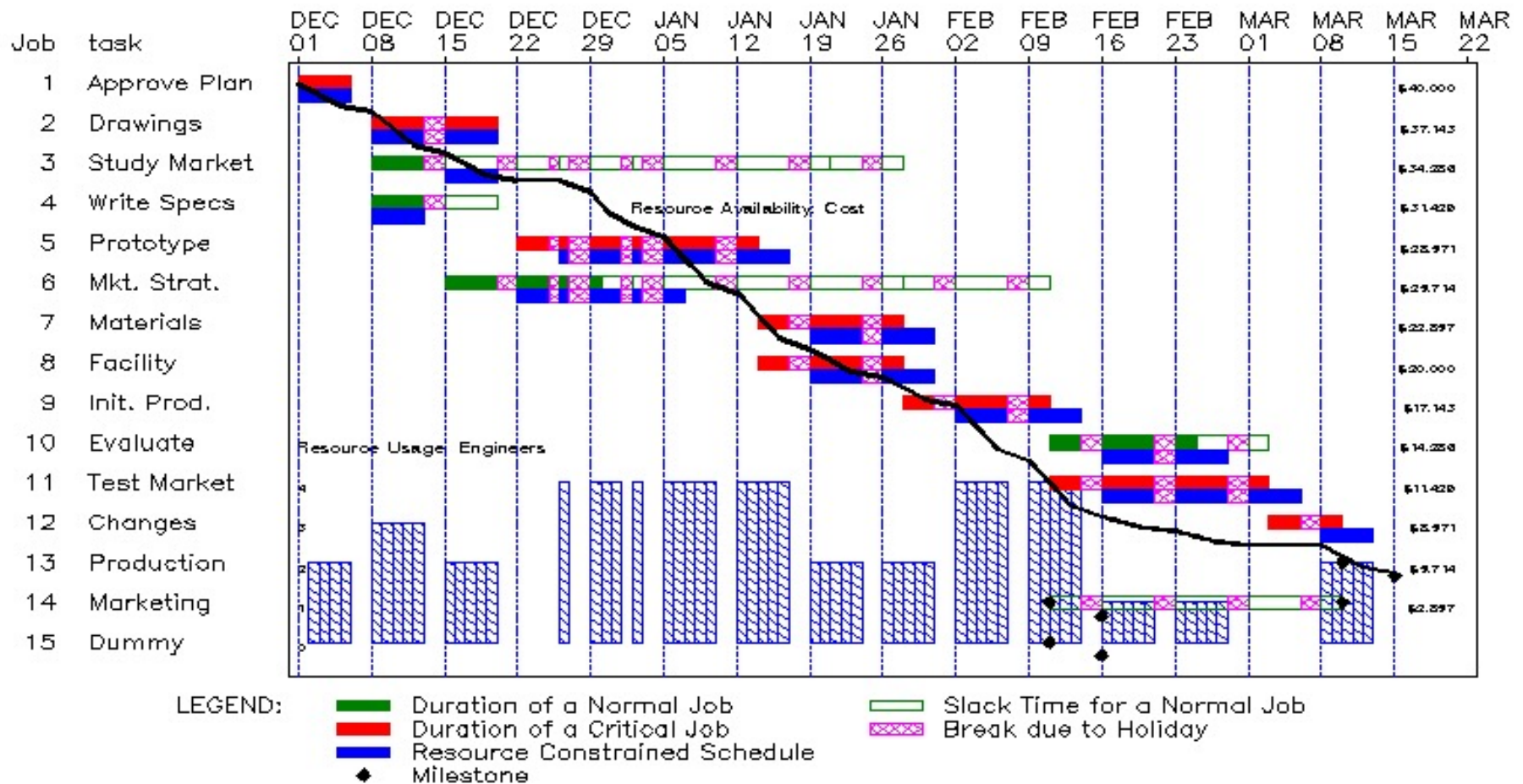
Retrofitting by adding RC shear walls



3. Who will do all activity and which means? (sources, materials, equipment, human resource)
4. When will activities be done? (sequencing and scheduling)

- **UNIT PRICES, BILL OF QUANTITIES, SCHEDULE**

Planning schedule



Quantity takeoff and Bill of quantities (BOQ)

- The bill of quantities is a document that provides project specific measured quantities of the items of work identified by the drawings and specifications.
- The quantities may be measured in number, length, area, volume, weight or time.
- Preparing a BOQ requires that the design is complete and a specification has been prepared.
- Wrong BOQ leads to wrong Cost estimations!

It is not a process that includes complicated mathematical operations.

Units should be proper and clearly seen on the document.

Once the quantities are obtained, they are multiplied by their respective units and total cost can be calculated by aggregating all items.

Repetitive items can be multiplied by the number of the item.

Calculated quantities should be marked and checked off from the drawings or list to prevent repetitions.

The voids in the buildings can be included in the initial calculations, then after finishing related calculations, they can be subtracted.

Some work items and their units

Yapılan İşler	Birimi	Yapılan İşler	Birimi
Kazı işleri	m ³	Kaplamalar	m ²
Toprak taşıma	m ³	Yarım tuğla duvar	m ²
Blokaj	m ³	Kalın tuğla duvar	m ³
Büz döşeme	m	Denizlikler	m
Beton işleri	m ³	Bordürler	m
Betonarme demirleri	ton	Sıva, boya işleri	m ²
İksalar	m ²	Badana	m ²
Kalıplar	m ²	Mozaik	m ²
İskeleler	m ²	Yalıtım işleri	m ²
Moloz taş duvar	m ³	Ahşap doğrama	m ²
Kesme taş duvar	m ³	Cam	m ²
Çatı örtüleri	m ²	Demir işleri	ton

Minha: Yapılması gereken bir iş için hesaplanan miktardan eksi kısımların düşülmesi. Duvar metraжі yaparken pencere ve kapıların hesaptan düşülmesi gibi.

Minha: Yapılması gereken bir iş için hesaplanan miktardan eksi kısımların düşülmesi. Duvar metrajı yaparken pencere ve kapılar hesaptan düşülme gibi.

YAPI METRAJ CETVELİ									
İşin Adı :						Sayfa Nu :			
Sıra Nu	Yapılan işler	Benzeri	Boyutlar			Miktar			Birimi
			Boy	En	Yük.	Azı	Minha	Çoğu	

DEMİR METRAJ CETVELİ

İlgili Olduğu İnşaat : İlgili Olduğu Yapı Elemanı : Sayfa Nu :

Sıra No.	Açıklama	Çap (ø)	Demir Boyu	Demir Sayısı	Benzet Sayısı	Toplam Demir Boyları ve Demirlerin Birim Ağırlıkları (kg/m)								
						ø8 0,395	ø10 0,617	ø12 0,888	ø14 1,208	ø16 1,578	ø18 1,998	ø20 2,466	ø22 2,984	ø24 3,551
Aktarılan (Nakli) Toplam														
Boylar Toplamı														
Ağırlıklar Toplamı														
İnce Demir Toplamı														
Kalın Demir Toplamı														
Yüklenici									Kontrol					

METRAJ ÖZETİ CETVELİ

İşin Adı : Sayfa Nu:.....

İşin Adı : Sayfa Nu:.....

[illegible]

Yüklenici	Kontrol
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Yüklenici	Kontrol
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Example

..... BİNASI MİMARİ KEŞİF ÖZETİ

SIRA POZ NO	İMALATIN ÇEŞİDİ	MIKTARI	
01 15.140/4	DOLGU		
132,50	m ³		
02 16.004	300 DZ. DEMİRSİZ BETON		
14,40	m ³		
03 16.022/1	DEMİRLİ BS.14 (B.160) BETONU	132,50	
m ³			
04 18.071/2	YATAY DELİKLİ (19x19x13,5 cm) TUĞLA DUVAR	131,32	m ³
05 18.071/3	YATAY DELİKLİ (19x19x13,5 cm) YARIM TUĞLA DUVAR	67,17	m ²
06 18.233/7	AHŞ.ÇATI ÜSTÜ 0,7mm. TRAPEZ ALÜ.LEV.ÇATI ÖRT.YAP.	1324,96	m ²
07 19.050/1	CAMYÜNÜ ŞİLTE İLE ISI YALITIMI TİP 18 (6 cm)	1324,96	m ²
08 19.050/2	İŞ.İLE ÇATI (0,5mm ALÜ. LEV. ÇATI ÖRT.YAP.)	1324,96	m ²

The total bill of quantities are obtained by multiplying unit prices and quantities of work itms.

Example for retrofitting

HİLMİ HAK İŞ MERKEZİ BİNASI'NIN **GÜÇLENDİRME** YAPILMASI DURUMUNDA YAKLAŞIK İNŞAAT MALİYETLERİ VE NAKİT AKIŞ ÇİZELGESİ

			2013 YILI		2014 YILI		TOPLAM
			0-6 AY	06-12 AY	12-18 AY	18-24 AY	1-48 AY
Toplam İnşaat masrafları	İmalat Yüzdelik Dilimi	5.596.530,0 TL	1.208.013,0 TL	1.518.840,0 TL	1.353.934,5 TL	1.515.742,5 TL	5.596.530,0 TL
Proje (Proje, Giderleri, Tadilat Ruhsat)	6%	352.950,0 TL	141.180,0 TL	141.180,0 TL	70.590,0 TL	0,0 TL	352.950,0 TL
Kırım, Söküm İşleri ve Molozların Atılması	5%	271.500,0 TL	190.050,0 TL	67.875,0 TL	13.575,0 TL	0,0 TL	271.500,0 TL
Temel Sömel ve Kirişlerin Açılması	4%	244.350,0 TL	244.350,0 TL	0,0 TL	0,0 TL	0,0 TL	244.350,0 TL
Mobilizasyon	2%	135.750,0 TL	67.875,0 TL	47.512,5 TL	13.575,0 TL	6.787,5 TL	135.750,0 TL
Kaba İnşaat Güçlendirme İşleri	18%	1.031.700,0 TL	515.850,0 TL	515.850,0 TL	0,0 TL	0,0 TL	1.031.700,0 TL
Kaba-İnce İşleri	5%	271.500,0 TL	0,0 TL	67.875,0 TL	108.600,0 TL	95.025,0 TL	271.500,0 TL
Mekanik-Elektrik İşleri	20%	1.113.150,0 TL	0,0 TL	278.287,5 TL	389.602,5 TL	445.260,0 TL	1.113.150,0 TL
İnce İşler	24%	1.357.500,0 TL	0,0 TL	339.375,0 TL	475.125,0 TL	543.000,0 TL	1.357.500,0 TL
Çatı İşleri	1%	54.300,0 TL	0,0 TL	0,0 TL	27.150,0 TL	27.150,0 TL	54.300,0 TL
Cephe İşleri	9%	487.080,0 TL	0,0 TL	0,0 TL	194.832,0 TL	292.248,0 TL	487.080,0 TL
Çevre Düzenleme İşleri	1%	33.210,0 TL	0,0 TL	0,0 TL	0,0 TL	33.210,0 TL	33.210,0 TL
Genel Gider	4%	243.540,0 TL	48.708,0 TL	60.885,0 TL	60.885,0 TL	73.062,0 TL	243.540,0 TL
GENEL İNŞAAT MASRAFI	100%	5.596.530,0 TL	1.208.013,0 TL	1.518.840,0 TL	1.353.934,5 TL	1.515.742,5 TL	5.596.530,0 TL

Example: rebuilding

HİLMİ HAK İŞ MERKEZİ BİNASI'NIN **YENİDEN** YAPILMASI DURUMUNDA YAKLAŞIK İNŞAAT MALİYETLERİ VE NAKİT AKIŞ ÇİZELGESİ

			2013 YILI		2014 YILI		TOPLAM
			0-6 AY	06-12 AY	12-18 AY	18-24 AY	1-48 AY
Toplam İnşaat masrafları	İmalat Yüzdelik Dilimi	5.252.360,0 TL	1.096.263,0 TL	1.447.615,0 TL	1.171.871,5 TL	1.296.610,5 TL	5.012.360,0 TL
Hafriyat Ve İksa İşleri	5%	240.000,0 TL					
Proje (Proje, Giderleri, Tadilat Ruhsat)	6%	300.950,0 TL	120.380,0 TL	120.380,0 TL	60.190,0 TL	0,0 TL	300.950,0 TL
Kırım, Söküm İşleri ve Molozların Atılması	10%	500.000,0 TL	350.000,0 TL	125.000,0 TL	25.000,0 TL	0,0 TL	500.000,0 TL
Temel Sömel ve Kirişlerin Açılması	0%	0,0 TL	0,0 TL	0,0 TL	0,0 TL	0,0 TL	0,0 TL
Mobilizasyon	3%	135.750,0 TL	67.875,0 TL	47.512,5 TL	13.575,0 TL	6.787,5 TL	135.750,0 TL
Kaba İnşaat Güçlendirme İşleri	19%	1.018.600,0 TL	509.300,0 TL	509.300,0 TL	0,0 TL	0,0 TL	1.018.600,0 TL
Kaba-İnce İşleri	4%	231.500,0 TL	0,0 TL	57.875,0 TL	92.600,0 TL	81.025,0 TL	231.500,0 TL
Mekanik-Elektrik İşleri	18%	949.150,0 TL	0,0 TL	237.287,5 TL	332.202,5 TL	379.660,0 TL	949.150,0 TL
İnce İşler	22%	1.157.500,0 TL	0,0 TL	289.375,0 TL	405.125,0 TL	463.000,0 TL	1.157.500,0 TL
Çatı İşleri	1%	54.300,0 TL	0,0 TL	0,0 TL	27.150,0 TL	27.150,0 TL	54.300,0 TL
Cephe İşleri	7%	387.860,0 TL	0,0 TL	0,0 TL	155.144,0 TL	232.716,0 TL	387.860,0 TL
Çevre Düzenleme İşleri	1%	33.210,0 TL	0,0 TL	0,0 TL	0,0 TL	33.210,0 TL	33.210,0 TL
Genel Gider	5%	243.540,0 TL	48.708,0 TL	60.885,0 TL	60.885,0 TL	73.062,0 TL	243.540,0 TL
GENEL İNŞAAT MASRAFI	100%	5.252.360,0 TL	1.096.263,0 TL	1.447.615,0 TL	1.171.871,5 TL	1.296.610,5 TL	5.012.360,0 TL

What to do:

- Define and sequence the work items in the project.
- Define the
- Establish project schedule by defining all activities.
- Calculate the quantities and prepare a BOQ.

- **OUTPUTS:**

1. TIME SCHEDULE (MS PROJECT)
2. COST ANALYSIS PREPARED BASED ON MINISTRY OF ENVIRONMENT AND URBANISATION UNIT PRICES (EXCEL) PREPARE A D REPORT EXPLAINING THE DETAILS OF COST ANALYSIS (WORD)