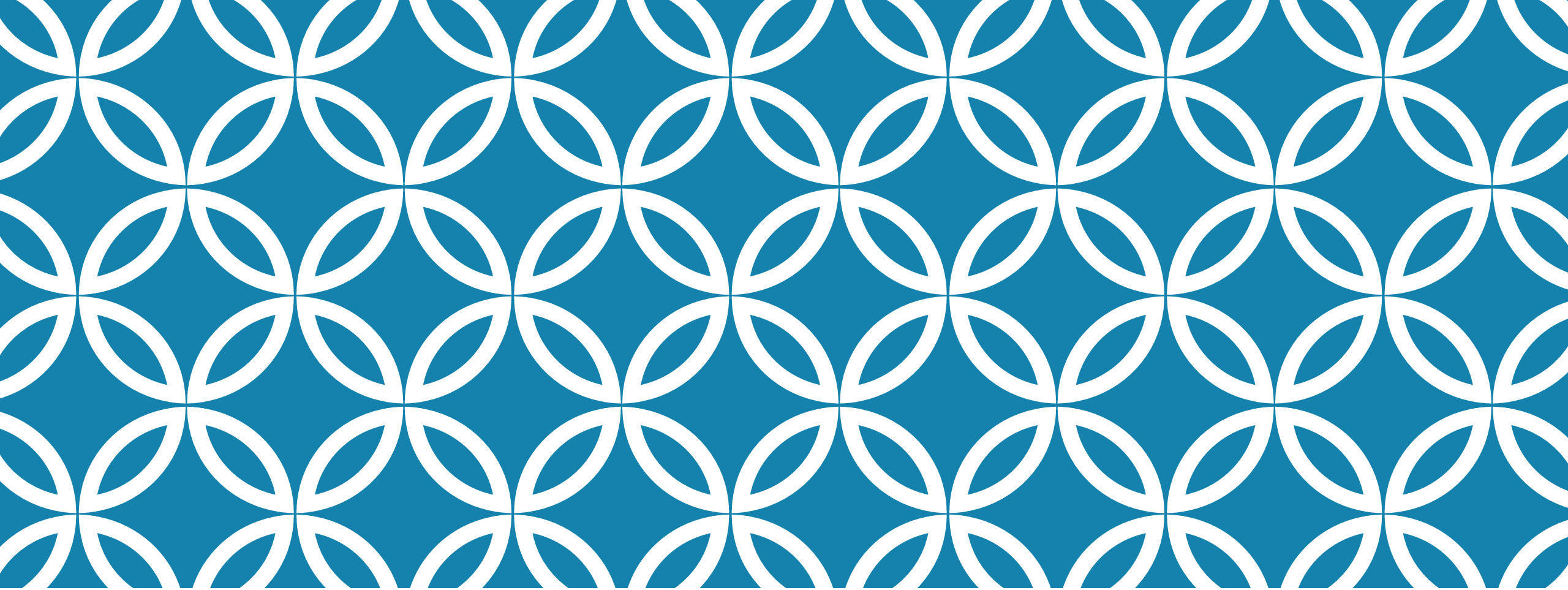
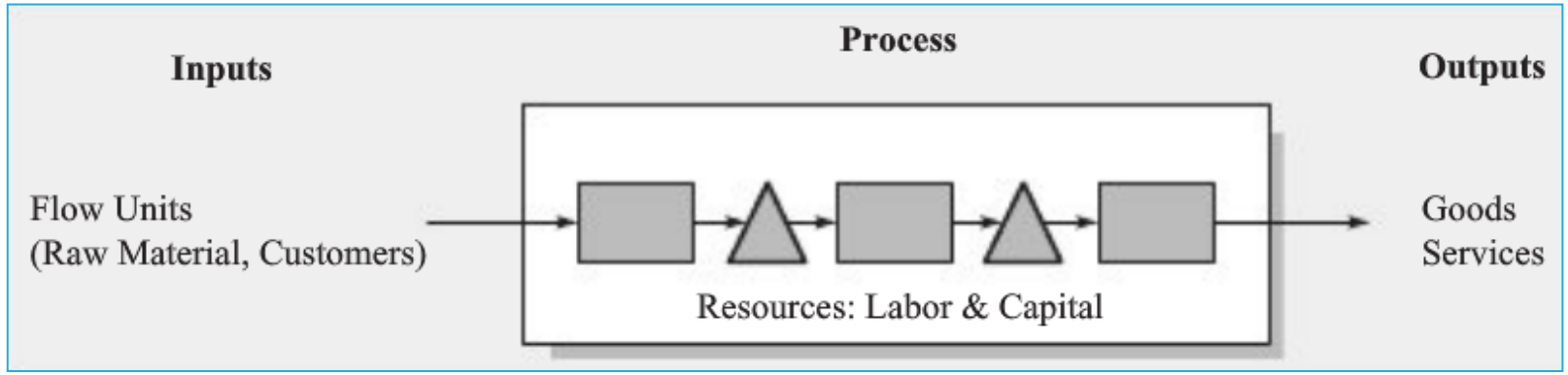


PROJECT OPERATION MANAGEMENT

CE 401: Project planning and construction management

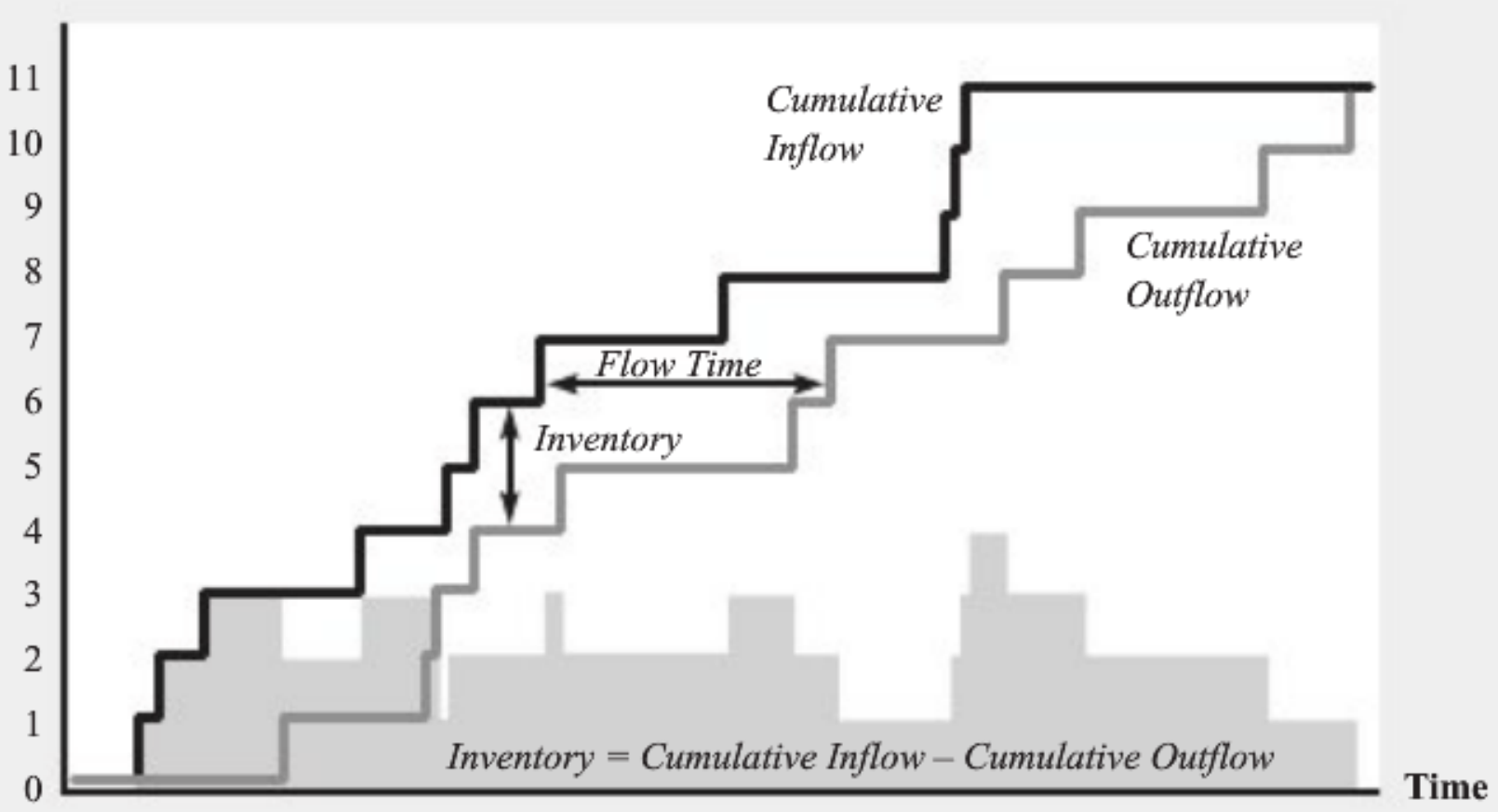
C1:INVENTORY MANAGEMENT: THE PROCESS VIEW



Flow Unit	Cement Bag
Flow Rate	100 bags/day
Flow Time	7 days
Inventory	700 bags

- The number of flow units contained within the process is called **Inventory**
- The time it takes a flow unit to get through the process is call **Flow Time** or **Throughput Time**
- The rate at which the process is delivering output is called **Flow Rate** or **Throughput Rate**

C1:INVENTORY MANAGEMENT: CUMULATIVE INFLOW AND OUTFLOW



C1:INVENTORY MANAGEMENT: LITTLE'S LAW AND INVENTORY TURNS

$$\text{Average inventory} = \text{Average flow rate} \times \text{Average flow time} \qquad \text{(Little's Law)}$$

$$\text{Inventory turns} = \frac{1}{\text{Flow time}}$$

Flow Unit	Site A - Cement Bag	Site B - Cement Bag
Flow Rate	100 bags/day	100 bags/day
Flow Time	7 days	30 days
Inventory	700 bags	3000 bags
Inventory Turns	52.14 turns/year	12.17 turns/year

C1:INVENTORY MANAGEMENT: DISADVANTAGES OF LOW INVENTORY TURNS

- Financial cost of holding large inventory
- Inventory may become obsolete
- Inventory may physically perish
- Risk of theft or shrink
- Requires storage space and overhead cost (insurance, security etc.)
- Cost occurred due to quality degradation

C1:INVENTORY MANAGEMENT: REASONS FOR HOLDING INVENTORY

- Use Pipeline Inventory for addressing the time a flow unit has to spend within the process
- Use Seasonal Inventory for taking care of seasonal variability in demand
- Use Cycle Inventory to take advantage of the economy of scale (e.g. reduce transportation cost)
- Use Buffer/Decoupling Inventory to make activities independent from each other
- Use Safety Inventory for tackling unforeseen events

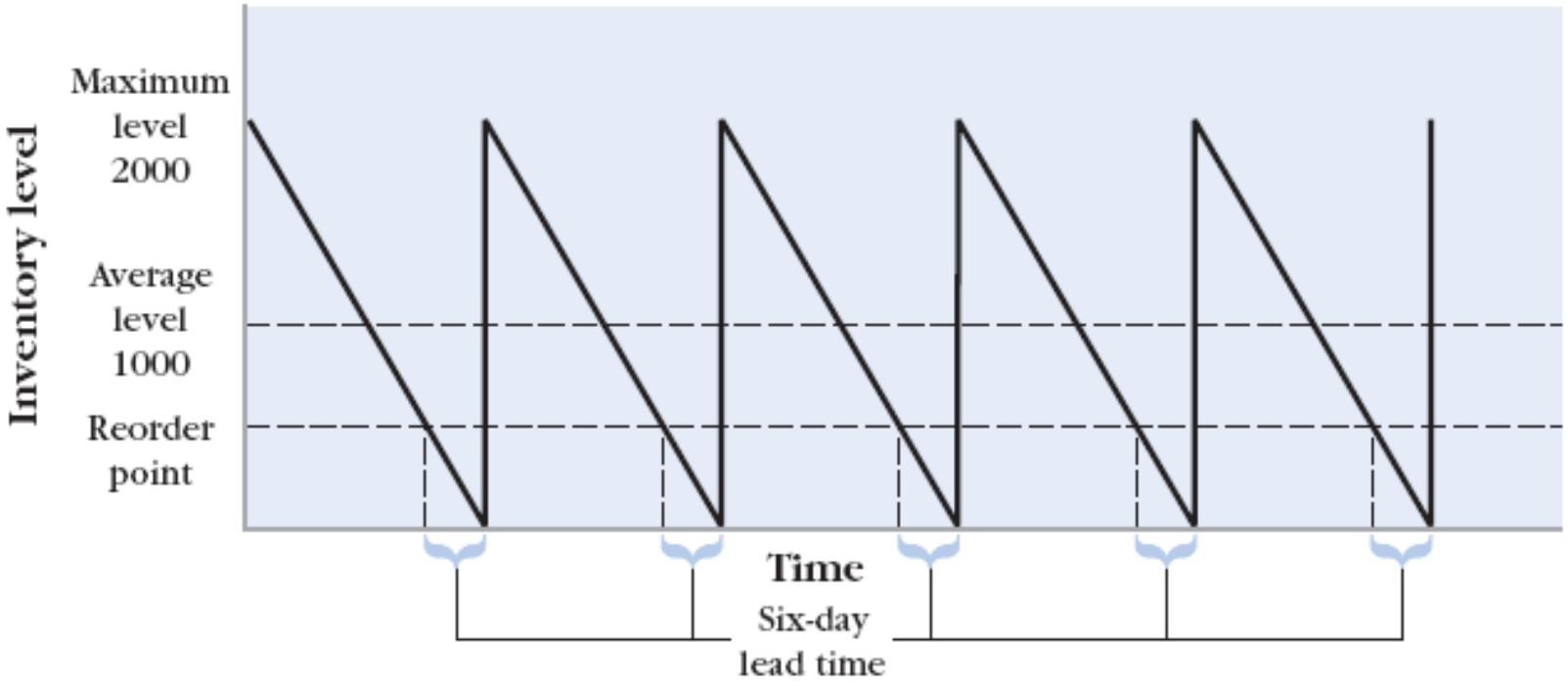
C1:INVENTORY MANAGEMENT: ECONOMIC ORDER QUANTITY (EOQ) MODEL

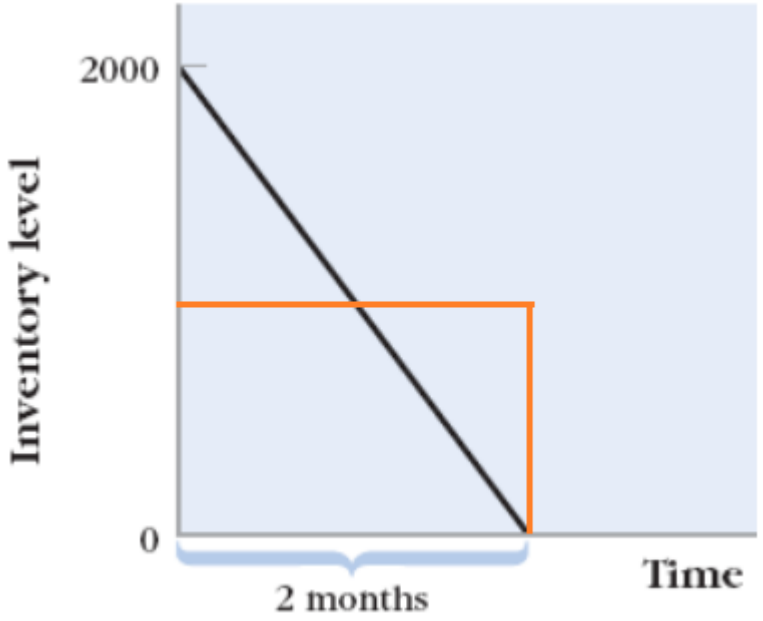
- EOQ model applier to items that are:
  - Replenished in batches or orders
  - Not produced and delivered instantaneously
- Only two costs are considered:
  - Inventory Carrying costs
  - Ordering costs
- Will decide
  - When to order
  - How many to order

C1:INVENTORY MANAGEMENT: ECONOMIC ORDER QUANTITY (EOQ) – ASSUMPTIONS

- Assumptions:
  - Constant rate of demand
  - Shortages not allowed
  - Stock replenishment can be scheduled to arrive exactly when inventory drops to zero
  - Purchase price, ordering cost, and per unit holding cost are independent of quantity ordered
  - Items are ordered independently of each other
- Notations
  - Q Order quantity
  - U Annual usage
  - C_O Order cost per order
  - C_H Annual holding cost per unit

C1:INVENTORY MANAGEMENT: ECONOMIC ORDER QUANTITY (EOQ) — COST IDENTIFICATION



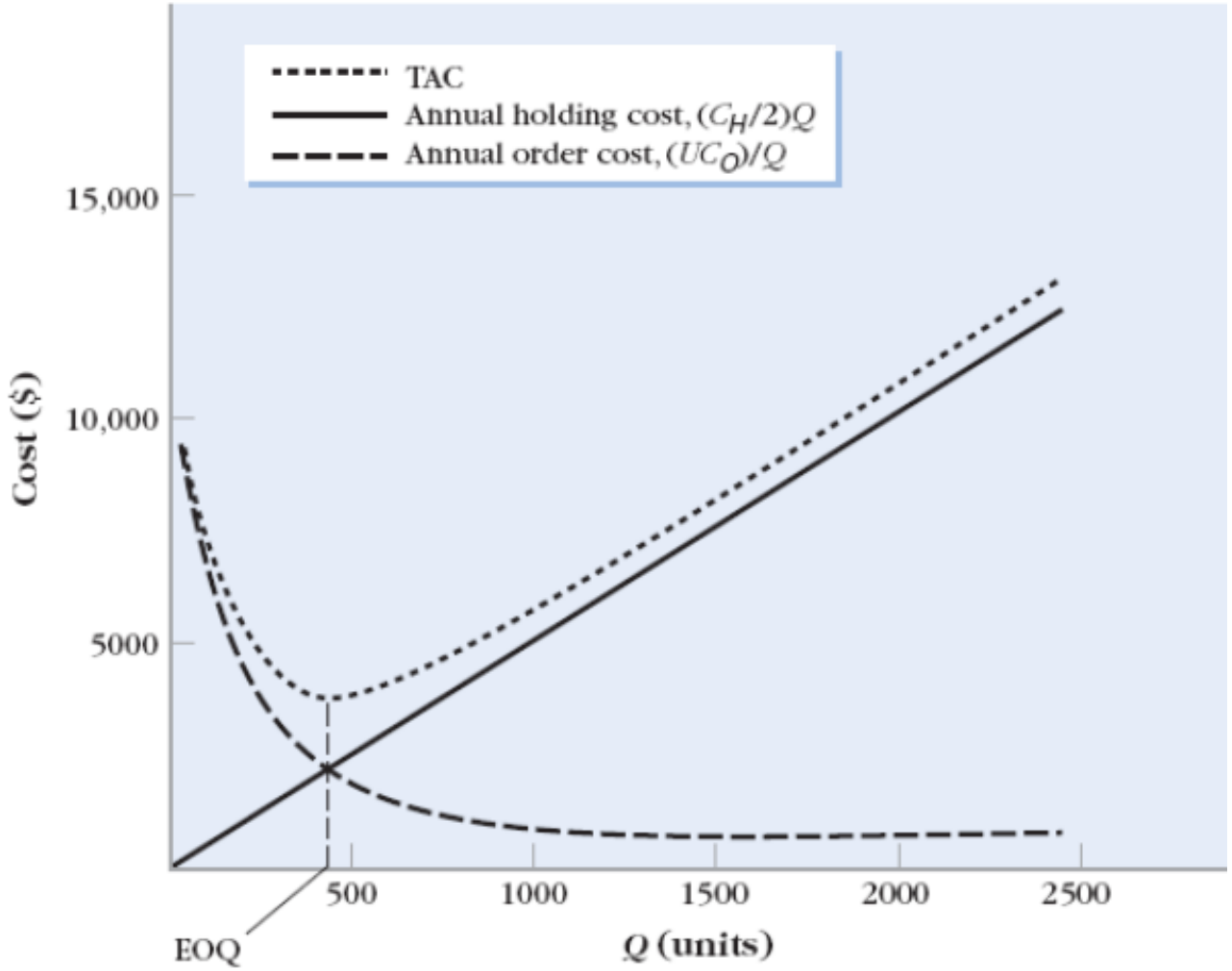


Annual holding cost, $(C_H/2)Q$

Annual order cost, $(UC_O)/Q$

$$TAC = \left(\frac{U}{Q}\right) C_o + \left(\frac{Q}{2}\right) C_H$$

C1:INVENTORY MANAGEMENT: ECONOMIC ORDER QUANTITY (EOQ) – GRAPHICAL REPRESENTATION



C1:INVENTORY MANAGEMENT: ECONOMIC ORDER QUANTITY (EOQ) – EQUATION

- Optimum Policy:

$$\left(\frac{Q}{2}\right)C_H = \left(\frac{U}{Q}\right)C_o$$

$$\left(\frac{Q^2}{2}\right)C_H = UC_o$$

$$Q^2 = \frac{2UC_o}{C_H}$$

$$EOQ = \sqrt{\frac{2UC_o}{C_H}}$$

C1:INVENTORY MANAGEMENT: ECONOMIC ORDER QUANTITY (EOQ) – EXAMPLE

- A Cement Bag Distributor,
  - Sells 1,000 bags a month
  - Lead time is six days
  - Cost of placing an order is $60
  - Cost of holding one bag in inventory is $10
- Optimum order quantity,

$$\text{EOQ} = \sqrt{\frac{2(12{,}000)\ 60}{10}} = \sqrt{144{,}000} = 379.6$$

$$\text{TAC} = \left(\frac{12{,}000}{380}\right) 60 + \frac{380}{2} 10 = 1894.74 + 1900 = \$3794.74$$

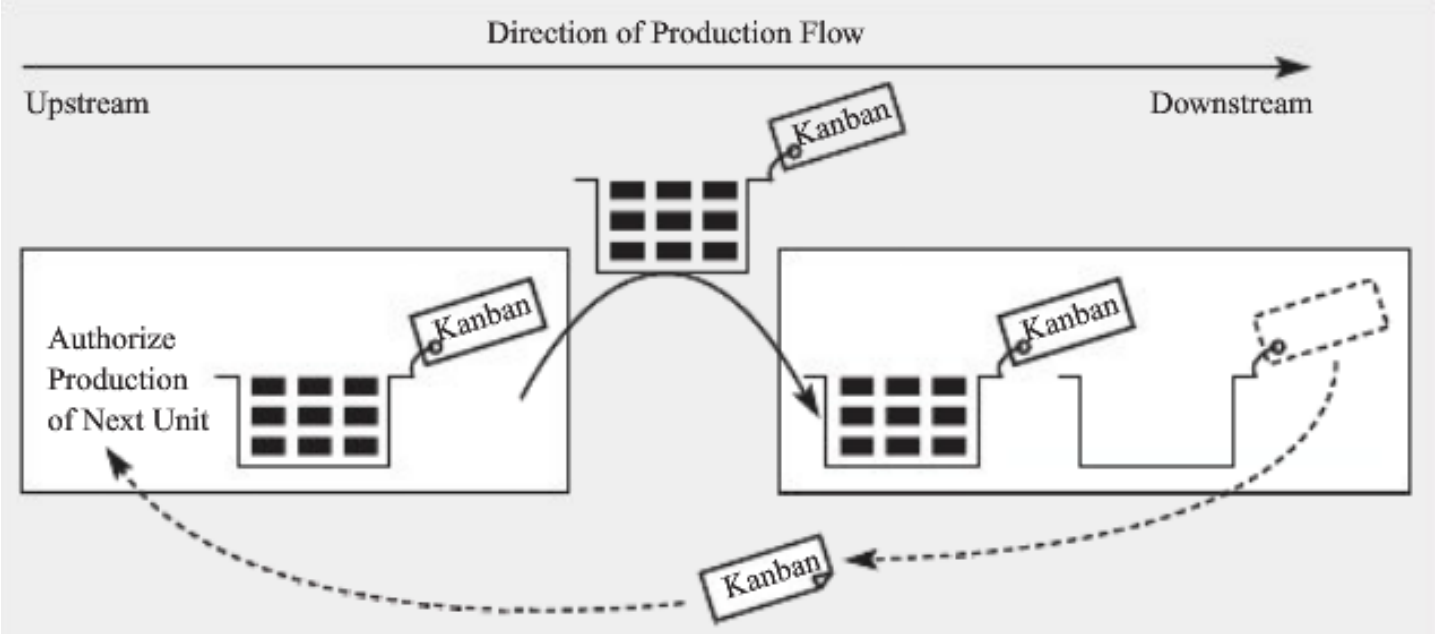
- Check: Six day requirement = 1000/30*6 = 200 bags < 380 bags. Ok.

C1:INVENTORY MANAGEMENT: JUST-IN-TIME (JIT)

- Just-in-Time is about matching supply with demand.
- JIT requires,
  - Achieve one-unit-at-a-time flow
  - Produce at the rate of customer demand
  - Implement a pull system using
    - Kanban, or
    - Make-to-order production
- In Kanban based pull system, the upstream replenished what demand has withdrawn from the downstream.
- Mark-to-order refers to release the work into a system only when a customer order has been received for that unit.

C1:INVENTORY MANAGEMENT: JUST-IN-TIME (JIT)

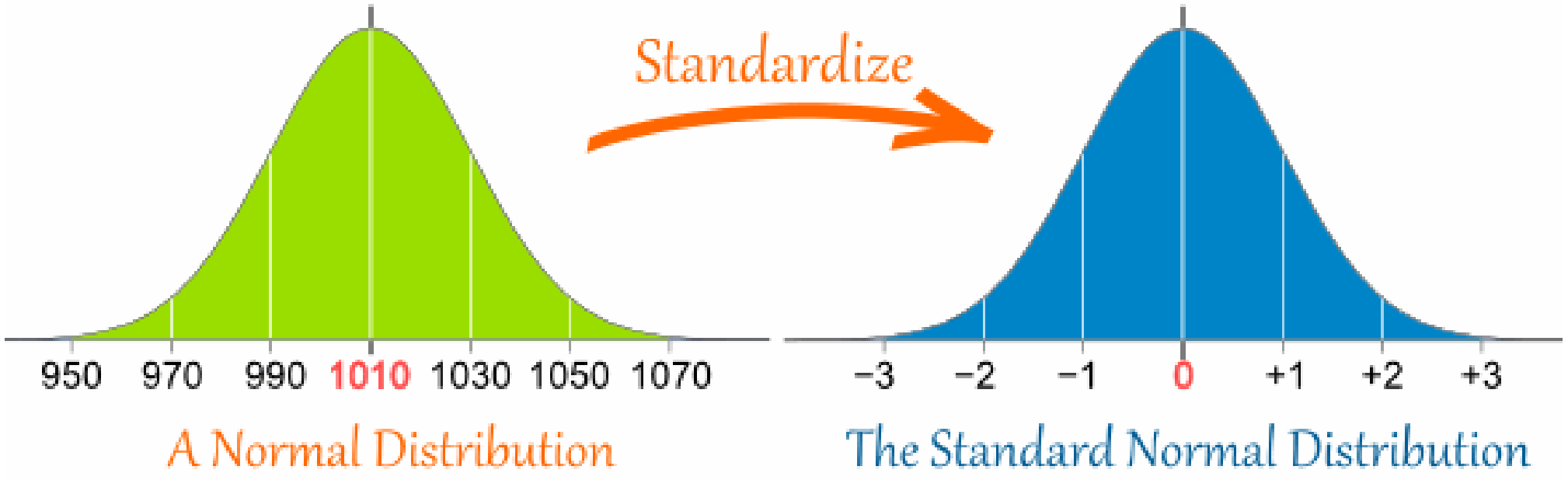
- Kanban should be used for,
  - High volume
  - Limited variability
  - Short lead time
  - Low storage cost
  - Ex: Cement Bags
- Mark-to-order should be used for,
  - Low volume
  - High variability
  - Customer willing to wait
  - High storage cost
  - Ex: Precast Girders



C2:DEMAND FORECASTING: NEWSVENDOR MODEL FOR OPTIMAL INVENTORY

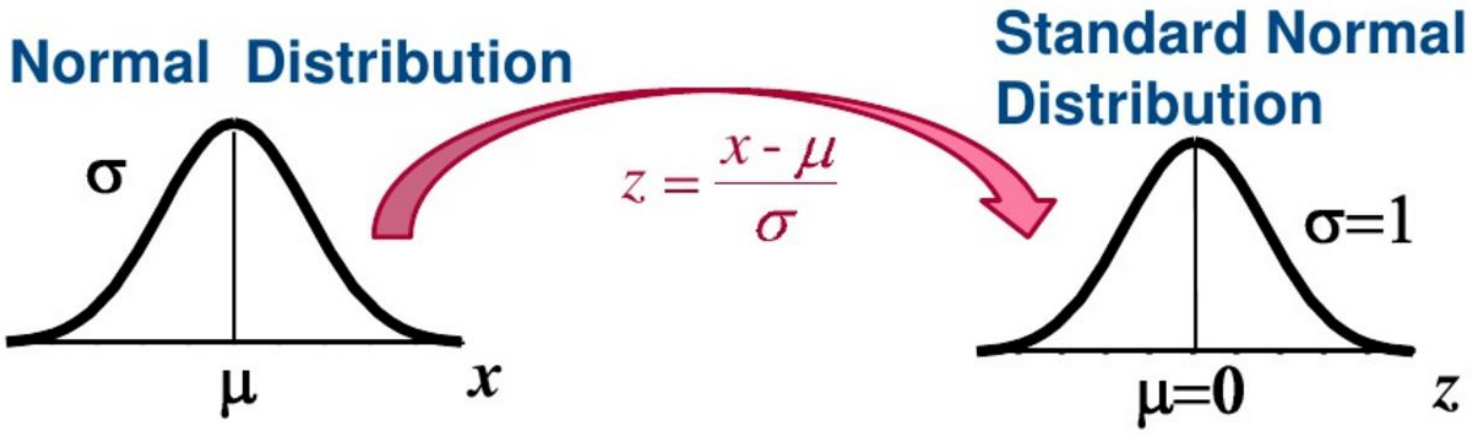
- suppose you are the owner of a simple business: selling newspapers. Each morning you purchase a stack of papers with the intention of selling them at your newsstand at the corner of a busy street. Even though you have some idea regarding how many newspapers you can sell on any given day, you never can predict demand for sure. Some days you sell all of your papers, while other days end with unsold newspapers to be recycled. As the newsvendor, you must decide how many papers to buy at the start of each day. Because you must decide how many newspapers to buy before demand occurs, unless you are very lucky, you will not be able to match supply to demand. A decision tool is needed to make the best out of this difficult situation. The *newsvendor model* is such a tool.

C2:DEMAND FORECASTING: REVIEWING STATISTICS



C2:DEMAND FORECASTING: REVIEWING STATISTICS

If each data value of a normally distributed random variable x is transformed into a z-score, the result will be the standard normal distribution.



Use the Standard Normal Table to find the cumulative area under the standard normal curve.

C2:DEMAND FORECASTING: REVIEWING STATISTICS

- To find the cumulative probability of a z-score equal to -1.31, cross-reference the row of the table containing -1.3 with the column containing 0.01. The table shows that *Prob*{the outcome of a standard normal *z* value is -1.31 or lower} is 0.0951; that is, P{z value <= -1.31} = 0.0951.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
...	...	...	...	...	...	...	...	...	...	...
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0722	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
...	...	...	...	...	...	...	...	...	...	...
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

C2:DEMAND FORECASTING: NEWSVENDOR MODEL – ASSUMPTIONS

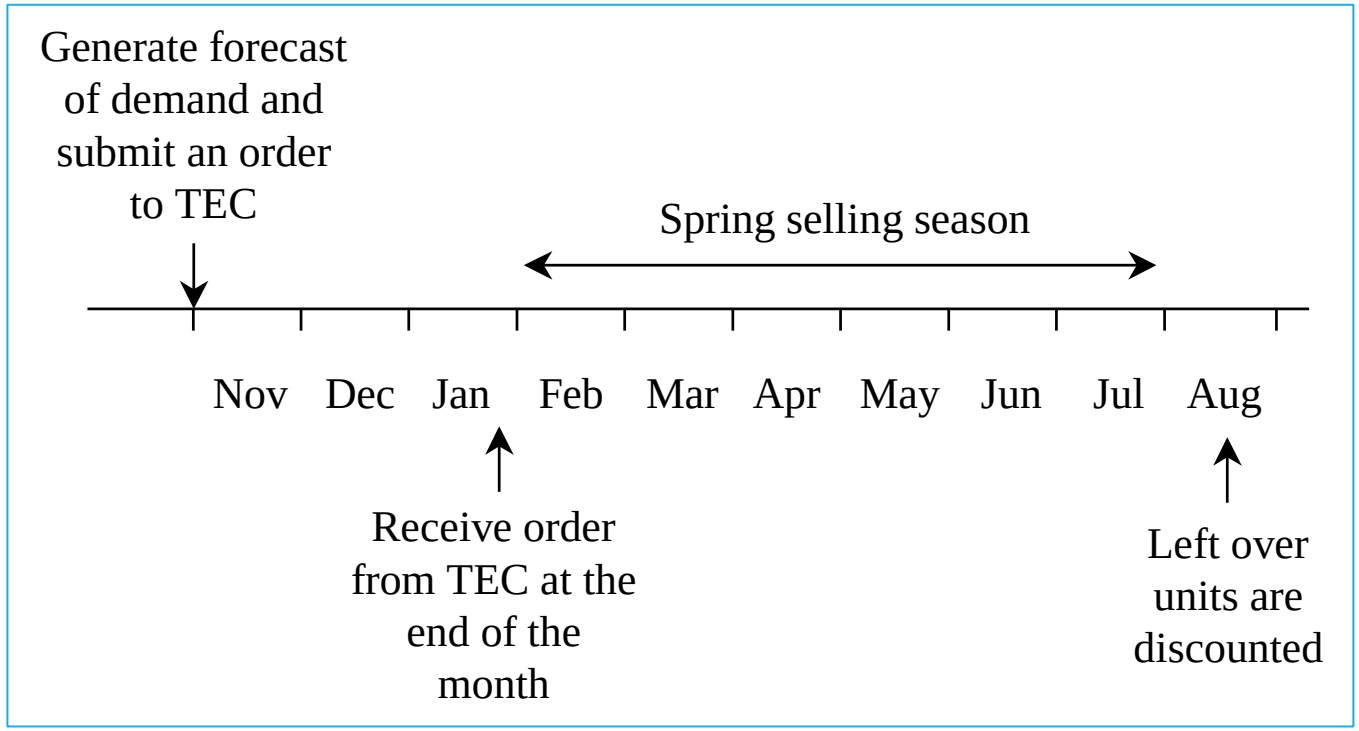
- One procurement/production opportunity
- Single sell period
- Receive entire order before the selling period
- Stochastic demand occurs in the selling period
- If demand exceeds the ordered quantity, entire order is sold
- If demand is less than the ordered quantity, you have leftover inventory at the end of the selling season

C2:DEMAND FORECASTING: NEWSVENDOR MODEL – PRODUCTION COST, SELLING PRICE, SALES PERIOD

- Selling price (p)
- Production/procurement cost (c)
- Salvage value of inventory (v)

Inputs for *Hammer 3/2*

- Each suit sells for, p = $180
- TEC charges, c = $110/suit
- Discounted suits sell for, v = $90



C2:DEMAND FORECASTING: NEWSVENDOR MODEL – DEMAND MODEL

- Demand is assumed as normally distributed (over time)
- Characterized by two parameters,
  - expected actual demand = μ
  - standard deviation of expected actual demand = σ
- These parameters are calculated based on previous forecasts and actual demands occurred

C2:DEMAND FORECASTING: NEWSVENDOR MODEL – DEMAND PARAMETERS

- Start with an initial forecast generated from survey, guesses, etc. (try to find the best guess) that O'Neill's initial forecast for the Hammer 3/2 = 3200 units, now,

Product description	Forecast	Actual demand	Error	A/F Ratio
JR ZEN FL 3/2	90	140	-50	1.5556
EPIC 5/3 W/HD	120	83	37	0.6917
JR ZEN 3/2	140	143	-3	1.0214
WMS ZEN-ZIP 4/3	170	156	14	0.9176
…	…	…	…	…
ZEN 3/2	3190	1195	1995	0.3746
ZEN-ZIP 4/3	3810	3289	521	0.8633
WMS HAMMER 3/2 FULL	6490	3673	2817	0.5659
Average				0.9975
Standard deviation				0.3690

- Evaluate the A/F ratios of the historical data as

$$A/F\ ratio = \frac{Actual\ demand}{Forecast}$$

- Set the mean of the normal distribution to

$$Expected\ actual\ demand = Expected\ A/F\ ratio \times Forecast$$

i.e., $Expected\ actual\ demand = 0.9975 \times 3200 = 3192$

- Set the standard deviation of the normal distribution to

$$\text{Standard deviation of actual demand} = \text{Standard deviation of A/F ratios} \times \text{Forecast}$$

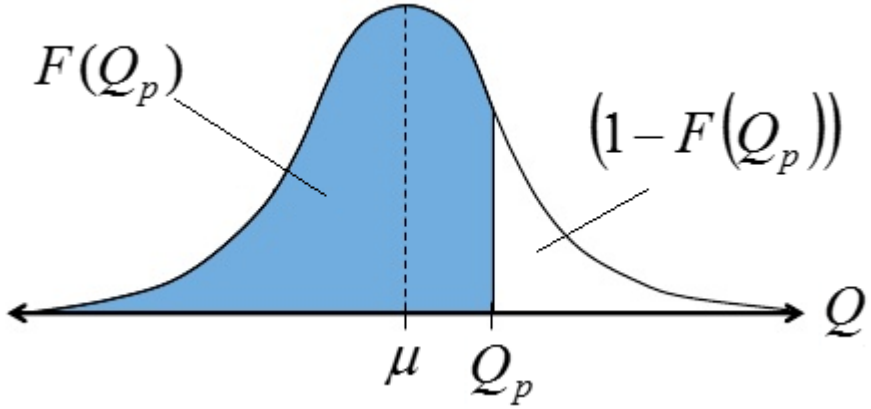
i.e., $Standard\ deviation\ of\ actual\ demand = 0.369 \times 3200 = 1181$

C2:DEMAND FORECASTING: NEWSVENDOR MODEL – OVERAGE AND UNDERAGE COST IDENTIFICATION

- C_o = overage cost
  - The cost of ordering one more unit than what you would have ordered had you known demand.
  - In other words, suppose you had left over inventory (i.e., you over ordered). C_o is the increase in profit you would have enjoyed had you ordered one fewer unit.
  - For the Hammer 3/2 C_o = *Cost* – *Salvage value* = $c - v = 110 - 90 = 20$
- C_u = underage cost
  - The cost of ordering one fewer unit than what you would have ordered had you known demand.
  - In other words, suppose you had lost sales (i.e., you under ordered). C_u is the increase in profit you would have enjoyed had you ordered one more unit.
  - For the Hammer 3/2 C_u = *Price* – *Cost* = $p - c = 180 - 110 = 70$

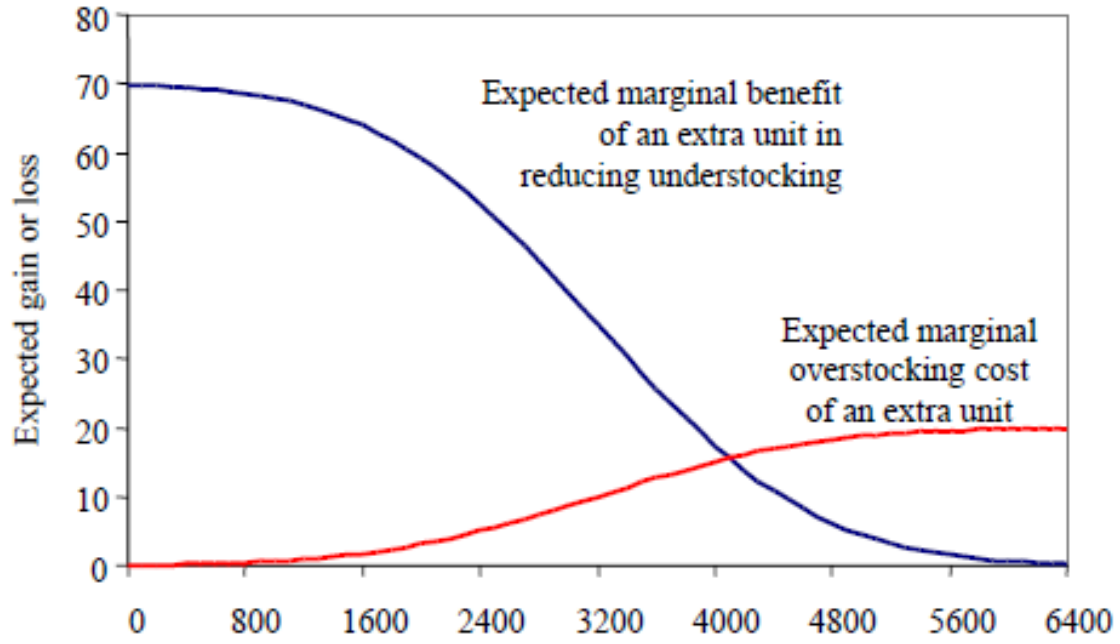
C2:DEMAND FORECASTING: NEWSVENDOR MODEL – EXPECTED LOSS AND BENEFIT

- Ordering one more unit increases the chance of overage. So,
  - Expected loss on the Q_p^{th} unit = C_o x $F(Q_p)$, where Probability of overage $F(Q_p)$ = $Prob\{Demand <= Q_p\}$
- But the benefit of ordering one more unit is the reduction in the chance of underage. So,
  - Expected benefit on the Q_p^{th} unit = C_u x (1-$F(Q_p)$) where Probability of underage 1-$F(Q_p)$



C2:DEMAND FORECASTING: NEWSVENDOR MODEL – OPTIMUM ORDER QUANTITY

- For the Optimum/Profit maximizing Order Quantity (Q_p), the expected marginal loss will be equal to the expected marginal benefit



As more units are ordered,

- the expected marginal benefit from ordering 1 more unit decreases
- while the expected marginal cost of ordering 1 more unit increases.

C2:DEMAND FORECASTING: NEWSVENDOR MODEL – OPTIMUM ORDER QUANTITY

- So, $C_o \times F(Q_p) = C_u \times (1 - F(Q_p))$
- Rearrange terms in the above equation -> $F(Q_p) = \frac{C_u}{C_o + C_u}$
- The ratio C_u / (C_o + C_u) is called the *critical ratio*.
- Hence, **to minimize the expected total cost of underage and overage, choose Q_p such that the Prob{Demand <= Q_p) equals the critical ratio.**

C2:DEMAND FORECASTING: NEWSVENDOR MODEL – OPTIMUM ORDER QUANTITY

- Now from the Prob{Demand <= Q_p) value for the Optimum Order Quantity (Q_p), find the the z-score from Standard Normal Table.

(Why? because, Prob{Demand <= Q_p) = Prob{z value <= z-score})

- As Q_p be the optimum order quantity, and (μ, σ) the parameters of the demand model, using the transformation rule we can find,

$$Q_p = \mu + z - score \times \sigma$$

because,

$$z = \frac{Q - \mu}{\sigma} \quad \text{or} \quad Q = \mu + z \times \sigma$$

C2:DEMAND FORECASTING: NEWSVENDOR MODEL – EXAMPLE

- Data: $p = 180$; $c = 110$; $v = 90$; $C_u = 180\text{-}110 = 70$; $C_o = 110\text{-}90 = 20$; critical ratio = 0.7778; mean = $\mu = 3192$; standard deviation = $\sigma = 1181$
- Look up critical ratio in the Standard Normal Distribution Function Table:

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389

- If the critical ratio falls between two values in the table, choose the greater *z*-score
- Choose *z*-score = 0.77

C2:DEMAND FORECASTING: NEWSVENDOR MODEL – EXAMPLE

- Convert the z-score into an order quantity:

$$Q_p = \mu + z - score \times \sigma$$
$$= 3192 + 0.77 \times 1181 = 4101$$

- Equivalently from Excel, Q_p = **NORMINV(0.778,3192,1181)** = 4096.003

C2:DEMAND FORECASTING: NEWSVENDOR MODEL – FINAL THOUGHTS

- Having a Forecast of Expected Demand is insufficient. Also need to know how the Demand will vary against the Forecast.
- Actual demand, past Forecast and Forecast error must be tracked.
- The Order Quantity assessment process must be separated from the initial Forecasting process.
- Order Quantity to maximize profit is only one objective. In practice, there may be multiple objectives that must be considered.
- The profit maximizing Order Quantity generally doesn't equal Expected Demand. If the underage cost is greater than the overage cost (i.e., it is more expensive to lose a sale than to have leftover inventory), then the profit maximizing Order Quantity is larger than the Expected Demand. On the other hand, if the overage cost is larger than underage cost, it is actually best to order less than the expected demand.

C3:LABOR AND PLANT MANAGEMENT: TASK DURATION

Worker	Tasks	Task Duration [seconds/unit]
Worker 1	Prepare cable	30
	Move cable	25
	Assemble washer	100
	Apply fork, threading cable end	66
	Assemble socket head screws	114
	Steer pin nut	49
	Brake shoe, spring, pivot bolt	66
	Insert front wheel	100
	Insert axle bolt	30
	Tighten axle bolt	43
	Tighten brake pivot bolt	51
	Assemble handle cap	118
		Total: 792

Worker	Tasks	Task Duration [seconds/unit]
Worker 2	Assemble brake lever and cable	110
	Trim and cap cable	59
	Place first rib	33
	Insert axles and cleats	96
	Insert rear wheel	135
	Place second rib and deck	84
	Apply grip tape	56
	Insert deck fasteners	75
		Total: 648
Worker 3	Inspect and wipe off	95
	Apply decal and sticker	20
	Insert in bag	43
	Assemble carton	114
	Insert Xootr and manual	94
	Seal carton	84
		Total: 450

C3:LABOR AND PLANT MANAGEMENT: AVERAGE UTILIZATION

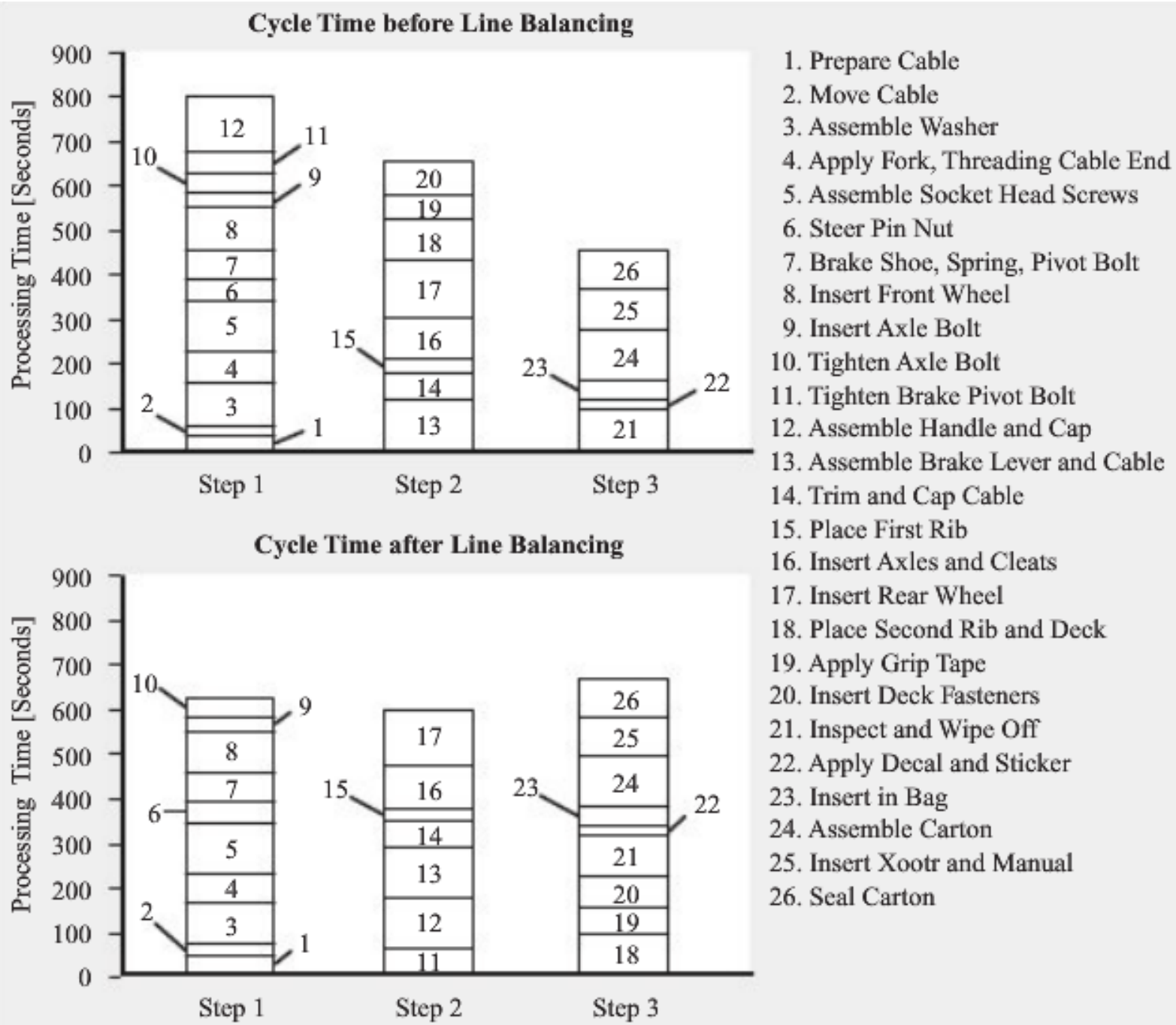
	Worker 1	Worker 2	Worker 3
Processing time	13 minutes/unit	11 minutes/unit	8 minutes/unit
Capacity	$\frac{1}{13}$ unit/minute	$\frac{1}{11}$ unit/minute	$\frac{1}{8}$ unit/minute
	= 4.61 units/hour	= 5.45 units/hour	= 7.5 units/hour
Process capacity	Minimum {4.61 units/h, 5.45 units/h, 7.5 units/h} = 4.61 units/hour		
Flow rate	Demand = 125 units/week = 3.57 units/hour Flow rate = Minimum {demand, process capacity} = 3.57 units/hour		
Cycle time	1/3.57 hours/unit = 16.8 minutes/unit		
Idle time	16.8 minutes/unit − 13 minutes/unit = 3.8 minutes/unit	16.8 minutes/unit − 11 minutes/unit = 5.8 minutes/unit	16.8 minutes/unit − 8 minutes/unit = 8.8 minutes/unit
Utilization	3.57/4.61 = 77%	3.57/5.45 = 65.5%	3.57/7.5 = 47.6%

$$\text{Average labor utilization} = \frac{1}{3} \times (\text{Utilization}_1 + \text{Utilization}_2 + \text{Utilization}_3) = 63.4\%$$

C3:LABOR AND PLANT MANAGEMENT: LINE BALANCING

- Now, for a peak demand of 200 units/week or 5.714 units/hr, worker 1 creates bottle neck and the system transforms from a Demand-constrained system to a Capacity-constrained system. The average utilization of the system is now (100%+84.6%+61.5%)/3 = 82%
- Though the average utilization is increased (i.e., labor cost decreased), the system is not optimized.
- Optimizing the system through line balancing,
  - Worker 1: 623 seconds per unit (674 − 51 seconds/unit).
  - Worker 2: 602 seconds per unit (635 + 51 − 84 seconds/unit).
  - Worker 3: 665 seconds per unit (581 + 84 seconds/unit).

$$\text{Average labor utilization} = \text{Labor content} / (\text{Labor content} + \text{Total idle time})$$
$$= 1{,}890/(1{,}890 + 42 + 63 + 0) = 94.7\%$$



1. Prepare Cable
2. Move Cable
3. Assemble Washer
4. Apply Fork, Threading Cable End
5. Assemble Socket Head Screws
6. Steer Pin Nut
7. Brake Shoe, Spring, Pivot Bolt
8. Insert Front Wheel
9. Insert Axle Bolt
10. Tighten Axle Bolt
11. Tighten Brake Pivot Bolt
12. Assemble Handle and Cap
13. Assemble Brake Lever and Cable
14. Trim and Cap Cable
15. Place First Rib
16. Insert Axles and Cleats
17. Insert Rear Wheel
18. Place Second Rib and Deck
19. Apply Grip Tape
20. Insert Deck Fasteners
21. Inspect and Wipe Off
22. Apply Decal and Sticker
23. Insert in Bag
24. Assemble Carton
25. Insert Xootr and Manual
26. Seal Carton

C3:LABOR AND PLANT MANAGEMENT: EXAMPLE PAVEMENT MAINTENANCE

Milling

Filling

Compacting

C3:LEAGAL & ETHICAL ISSUES: OCCUPATIONAL HEALTH & SAFETY

- Bangladesh Labour Law (2006), Bangladesh Labour (Amendment) Law (2013) and Bangladesh Labour Rules & Regulations (2015)
- Safety committee
- Workplace health centre
- Compensation
- Cost of treatment
- Inspections
- Personal Protective Equipment (PPE)

C3:LEAGAL & ETHICAL ISSUES: ANTI-DISCRIMINATION

- Equal Employment Opportunity (EEO)
- Gender Diversity
- Bullying and Harassment
- Complaint management

C3:LEAGAL & ETHICAL ISSUES: RESPONDING TO WORKPLACE BULLYING

- Act promptly
- Treat all matters seriously
- Maintain confidentiality
- Ensure procedural fairness
- Be neutral
- Support all parties
- Do not victimize
- Communicate process and outcomes
- Keep records

C3:LEAGAL & ETHICAL ISSUES: STANDARDS AND ETHICS

- Engineering Code of Ethics
- Bangladesh National Building Code (BNBC)
- Building Construction Act
- Anti-corruption Commission
- Public Procurement Act, Rules & Regulations

C4:PROCUREMENT: VALUE FOR MONEY

18 Lac

Is this car gives a Good Value for Money?

C4:PROCUREMENT: VALUE FOR MONEY

18 Lac

1. VfM is always Relative. One option in not intrinsically Good or Bad unless you compare with other options

Is this car gives a Good Value for Money?

We don't know as we can't compare with other option

C4:PROCUREMENT: VALUE FOR MONEY

10 Lac

18 Lac

Now which car gives better Value for Money?

C4:PROCUREMENT: VALUE FOR MONEY

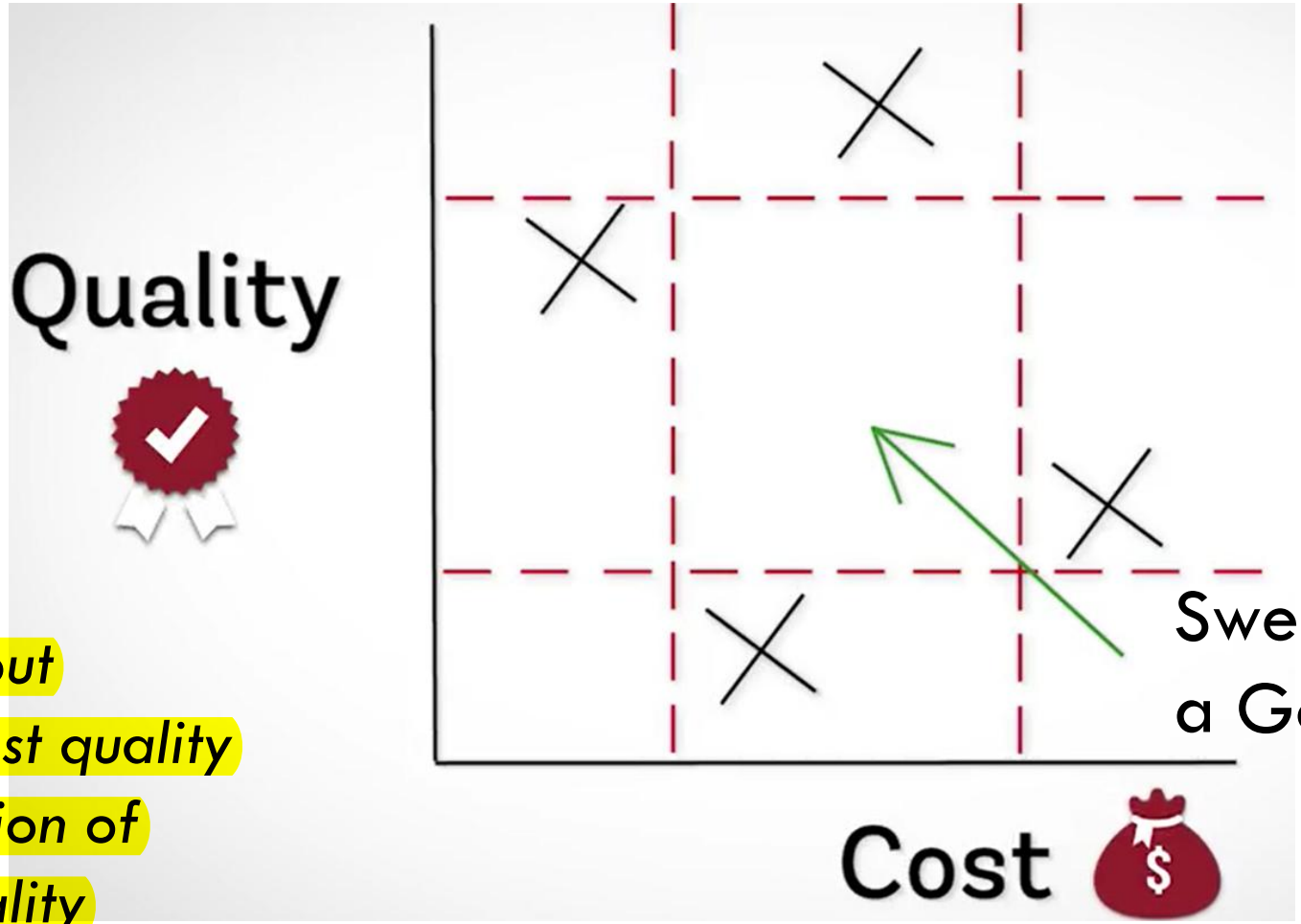
10 Lac

18 Lac

Now which car gives better Value for Money?

What about quality?

C4:PROCUREMENT: VALUE FOR MONEY – COST & QUALITY



2. *VfM is not about cheapest or highest quality but is a combination of both cost and quality*

C4:PROCUREMENT: VALUE FOR MONEY

10 Lac, Make 2006

18 Lac, Make 2016

Now which one gives better Value for Money?

C4:PROCUREMENT: VALUE FOR MONEY

10 Lac, Make 2006

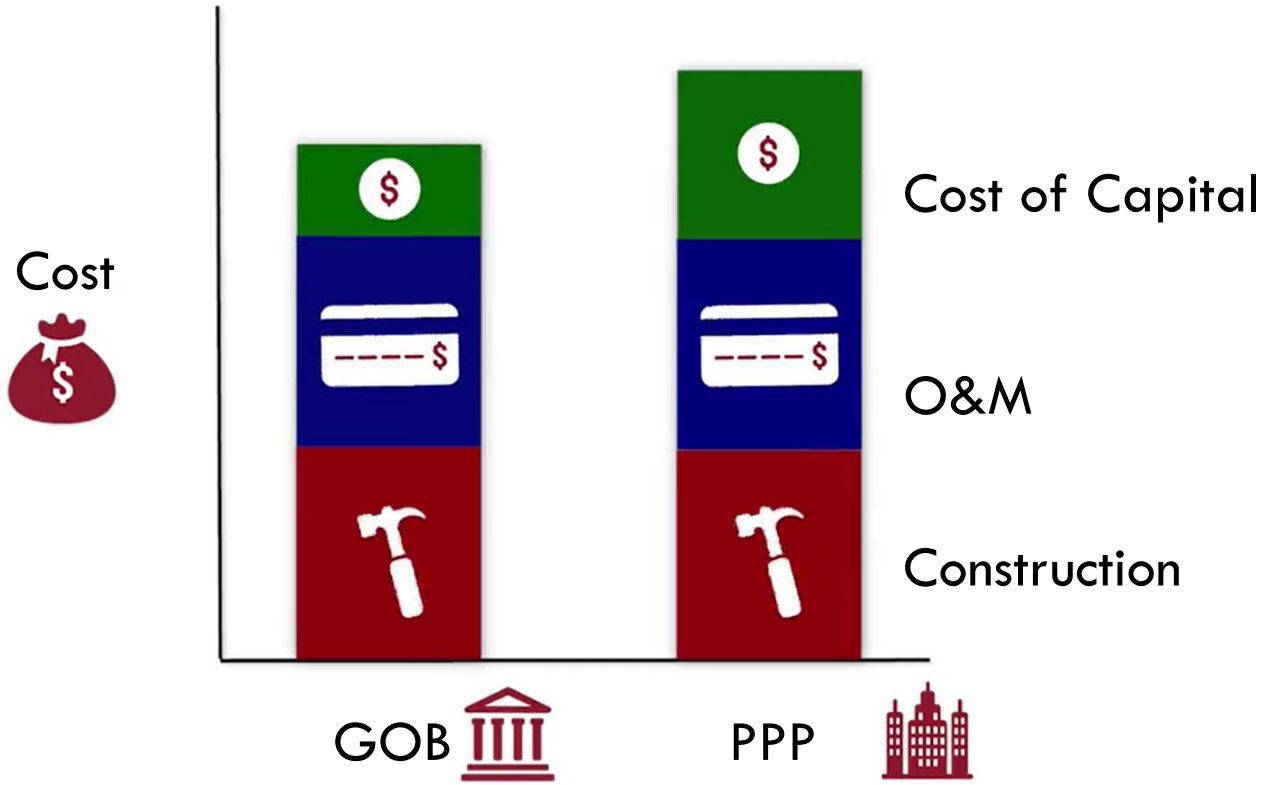
18 Lac, Make 2016

Now which one gives better Value for Money?

It depends! what about future risk for the whole life (say 20 years) of the car?

C4:PROCUREMENT: VALUE FOR MONEY – RISK TRANSFER AND WHOLE LIFE OF ASSET

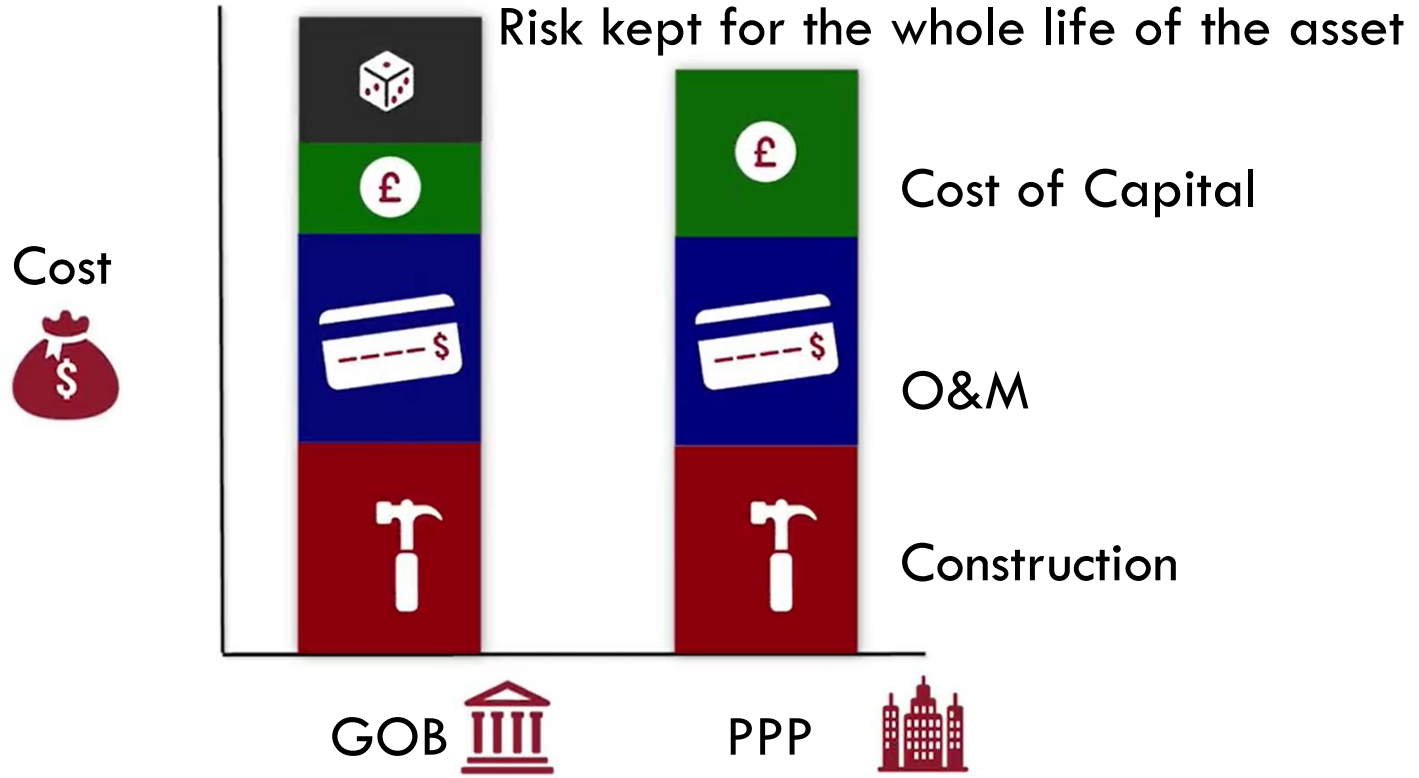
Which one provides better VfM, GOB or PPP?
Risk and Whole Life is not considered!!



C4:PROCUREMENT: VALUE FOR MONEY – RISK TRANSFER AND WHOLE LIFE OF ASSET

Which one provides better VfM, GOB or PPP?

Considering the risk transferred, PPP gives Good VfM



3. *For better VfM option, one should also consider the risk transferred and whole life of the asset*

C4:PROCUREMENT: VALUE FOR MONEY

10 Lac, Make 2006

Comes with 20yrs warranty

18 Lac, Make 2016

New car have a life of 20yrs without any issue

Now which one gives better Value for Money?

To me, Blue Car

C4:PROCUREMENT: METHODS

- Procuring works designed by the Employer
- Design-Build Procurement
- Performance Based Maintenance
- EPC/Turnkey Procurement
- PPP Procurement

C4:PROCUREMENT: PROCURING WORKS DESIGNED BY THE EMPLOYER

- Construction works where the design is carried out by the Employer
- Administration of the project and supervision of the works is carried out by an Engineer who is employed by the Employer. The engineer is responsible, amongst other things, for issuing instructions, certifying payments and determining completion.
- Payments are normally determined by measurement and applying the rates and prices from the bill of quantities.

C4:PROCUREMENT: DESIGN-BUILD PROCUREMENT

- Construction works where the design is carried out by the Contractor. Under the usual arrangements for this type of procurement, the Contractor designs and provides the works in accordance with the Employer's requirements which may include any combination of civil, mechanical, electrical and/or construction works.
- Administration of the project and supervision of the works is carried out by an Engineer who is employed by the Employer. The Engineer is responsible, amongst other things, for issuing instructions, certifying payments and determining completion.
- Interim payments of the lump sum Contract Price are made as work proceeds, and are typically based on instalments specified in a schedule Where the engineer is required to determine a matter or settle a claim he is required to consult with each of the parties to try and reach an agreement.

C4:PROCUREMENT: PERFORMANCE BASED MAINTENANCE

- A maintenance approach where a private contractor assumes responsibility for managing the condition of transportation assets to predefined conditions.
- Performance standards are specified instead of maintenance techniques. Shifts the risk from the owner agency to the contractor.
- Contractor receives a schedule of payments in return for an agreed upon level of performance.
- Often combined with ‘Procuring works designed by the Employer’ or ‘Design-Build procurement (also known as Design-Build-Operate Procurement)’.

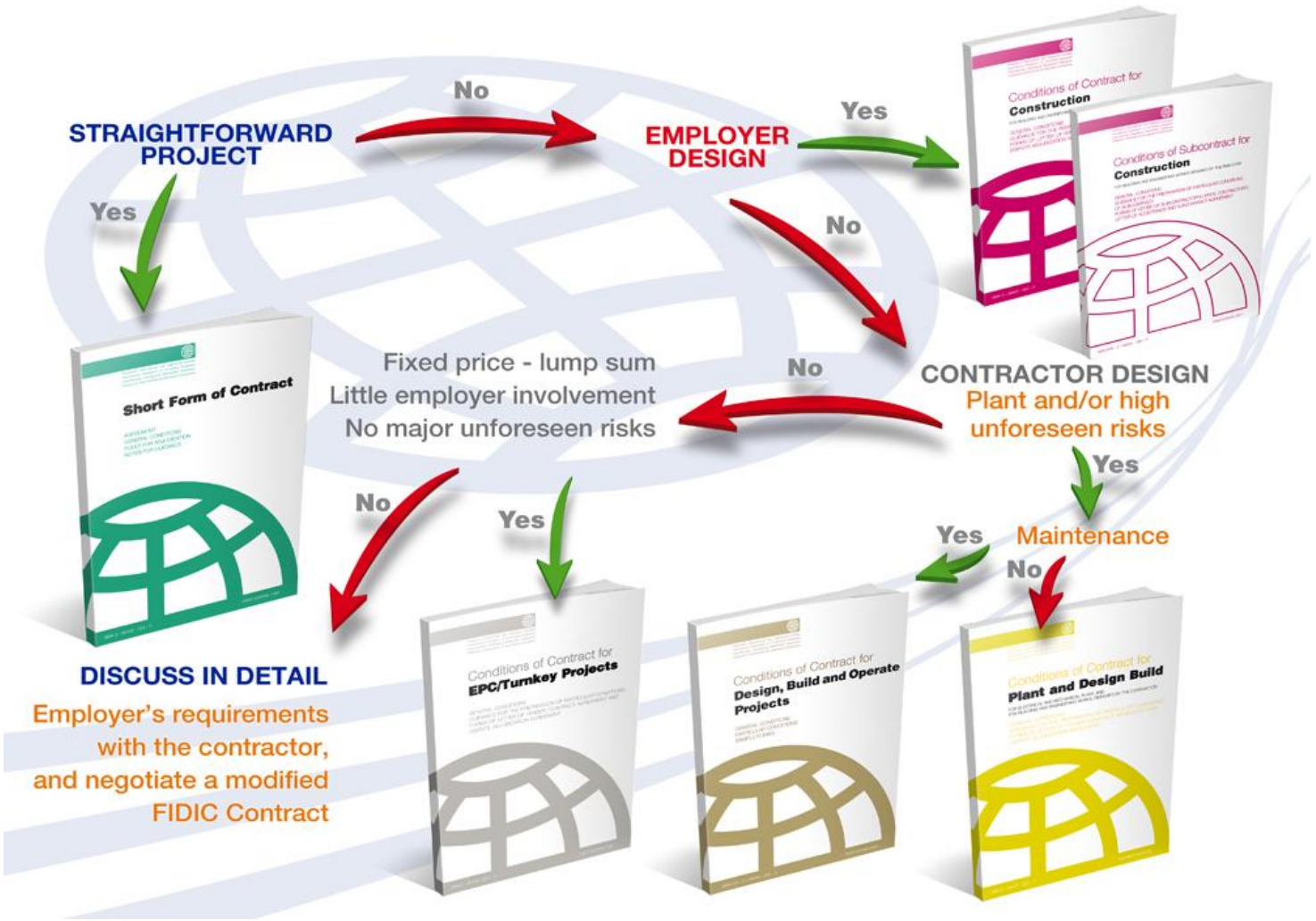
C4:PROCUREMENT: EPC/TURNKEY PROCUREMENT

- A Contractor is to take on full responsibility for the design and execution of a project. Risks for completion to time, cost and quality are transferred to the Contractor. So, only suitable for use with experienced Contractors familiar with sophisticated risk management techniques
- To obtain this increased cost certainty this procurement requires the Contractor to accept a higher level of risk than is typical under most other forms of procurement
- Following award of a project, the Contractor will be given freedom to carry out the work in his chosen manner, provided the end result meets the performance criteria specified by the Employer. Consequently, the Employer should only exercise limited control over the Contractor's work.
- Taking Over only takes place after successful completion of the "Tests on Completion"

C4:PROCUREMENT: PPP PROCUREMENT

- A Public Private Partnership (PPP) is an arrangement between the public and private sectors with clear agreement on shared objectives for the delivery of public infrastructure and/or public services by the private sector that traditionally would have been supplied by conventional public sector procurement
- Under Public Private Partnership arrangements, private sector contractors become long term providers of services rather than simply upfront asset builders, combining the responsibilities of designing, building, operating, maintaining and possibly financing assets in order to deliver the services needed by the public sector
- PPP projects can deliver a solution that provides services to citizens, enables the government to meet its responsibility of provision of services while providing the requisite financial returns to the private sector. Hence well-structured PPP projects are widely acknowledged to deliver a 'win-win solution' that benefits all stakeholders

C4:PROCUREMENT: FIDIC DOCUMENTS



C5: ENVIRONMENTAL REGULATIONS: GUEST LECTURE

Location: TBA

Date: TBA

Time: TBA

Attendance is mandatory

C5:ENVIRONMENTAL REGULATIONS: LAW

Bangladesh Environment Conservation Act 1995 and Rule 1997,

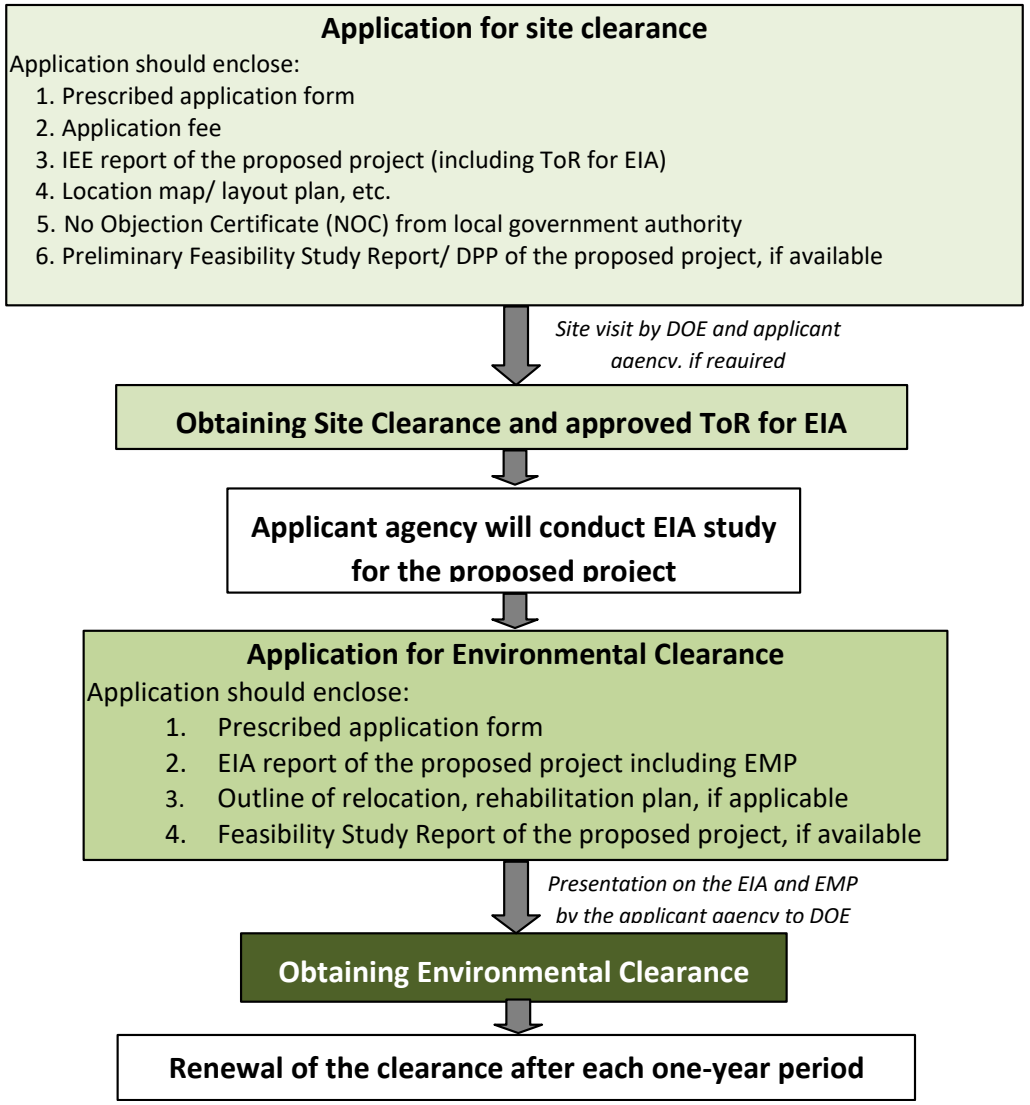
- Establishment of the Department of Environment (DoE)
- Procedure for Environmental Clearance Certificate
- Categorized list of the projects as green, orange and red
- Ambient standards in relation to water pollution, air pollution and noise, as well as permitted discharge/emission levels of water and air pollutants and noise by projects Environmental Categories
- Abbreviations
  - IEE – Initial Environmental Examination
  - EIA – Environmental Impact Assessment
  - EMP – Environmental Management Plan

C5:ENVIRONMENTAL REGULATIONS: ENVIRONMENTAL CLEARANCE

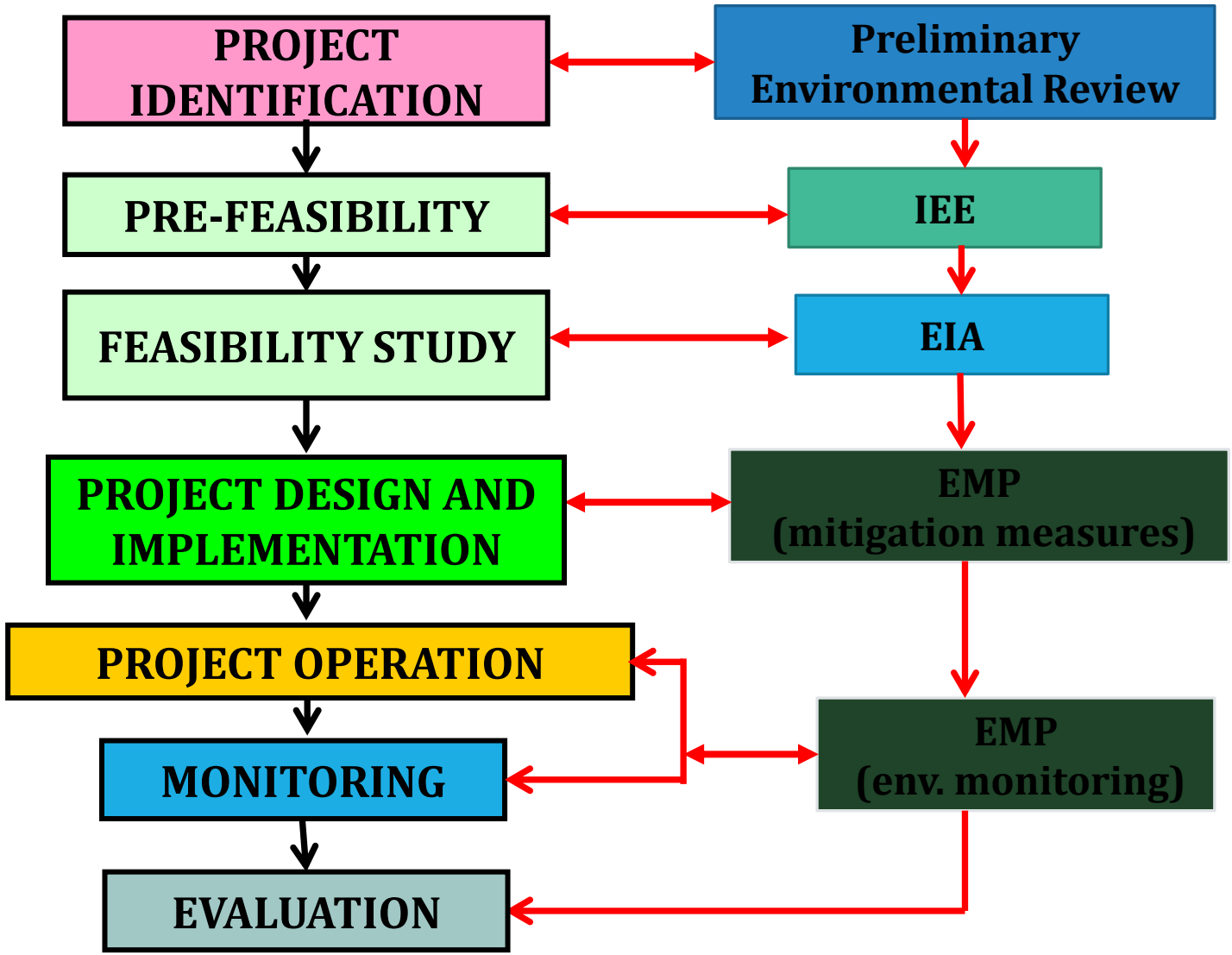
New and existing projects/industries are given environmental clearance based on their respective classification:

- Green
- Orange-A
- Orange-B
- Red

} Location clearance required



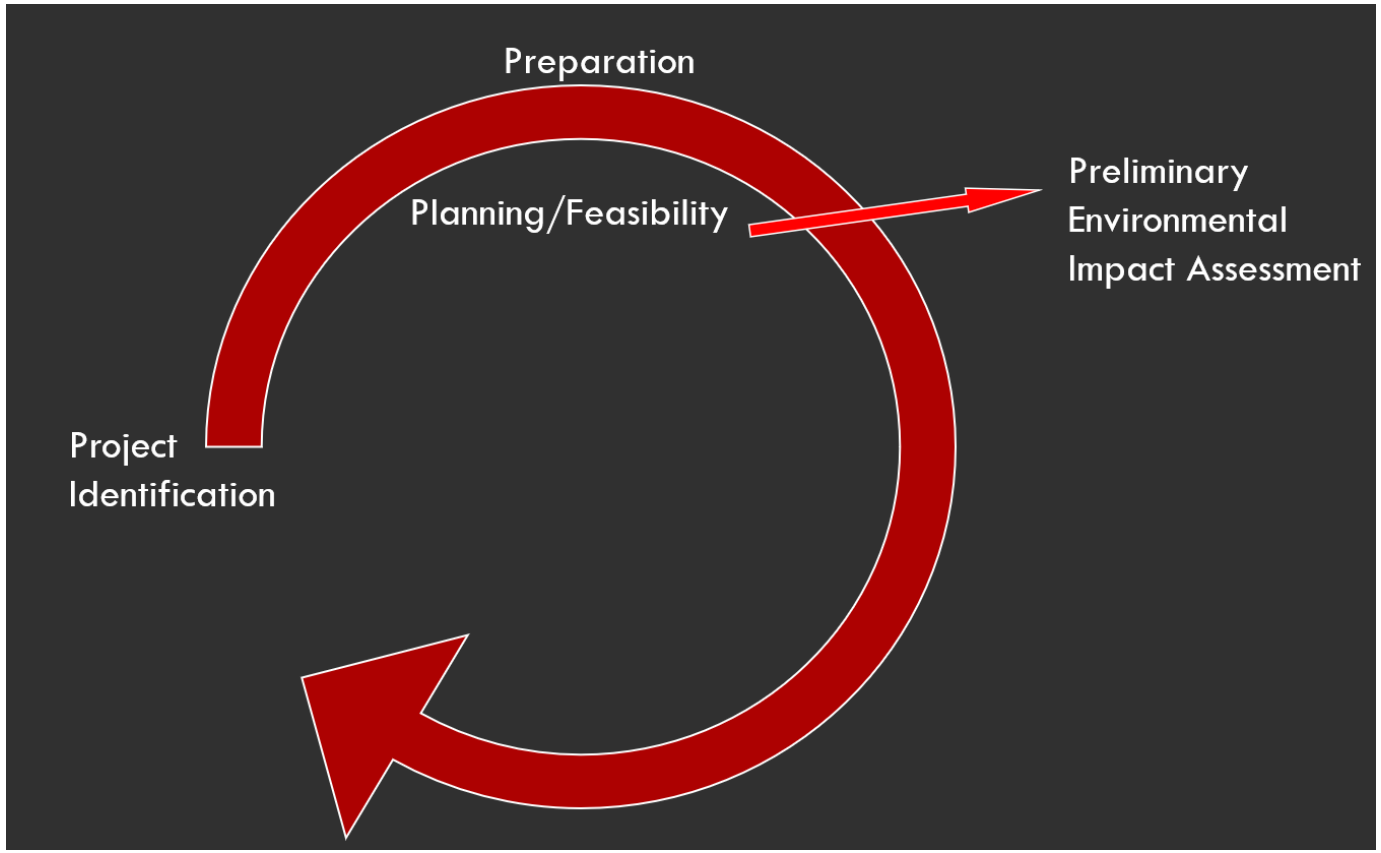
C5:ENVIRONMENTAL REGULATIONS: PROJECT LIFE CYCLE



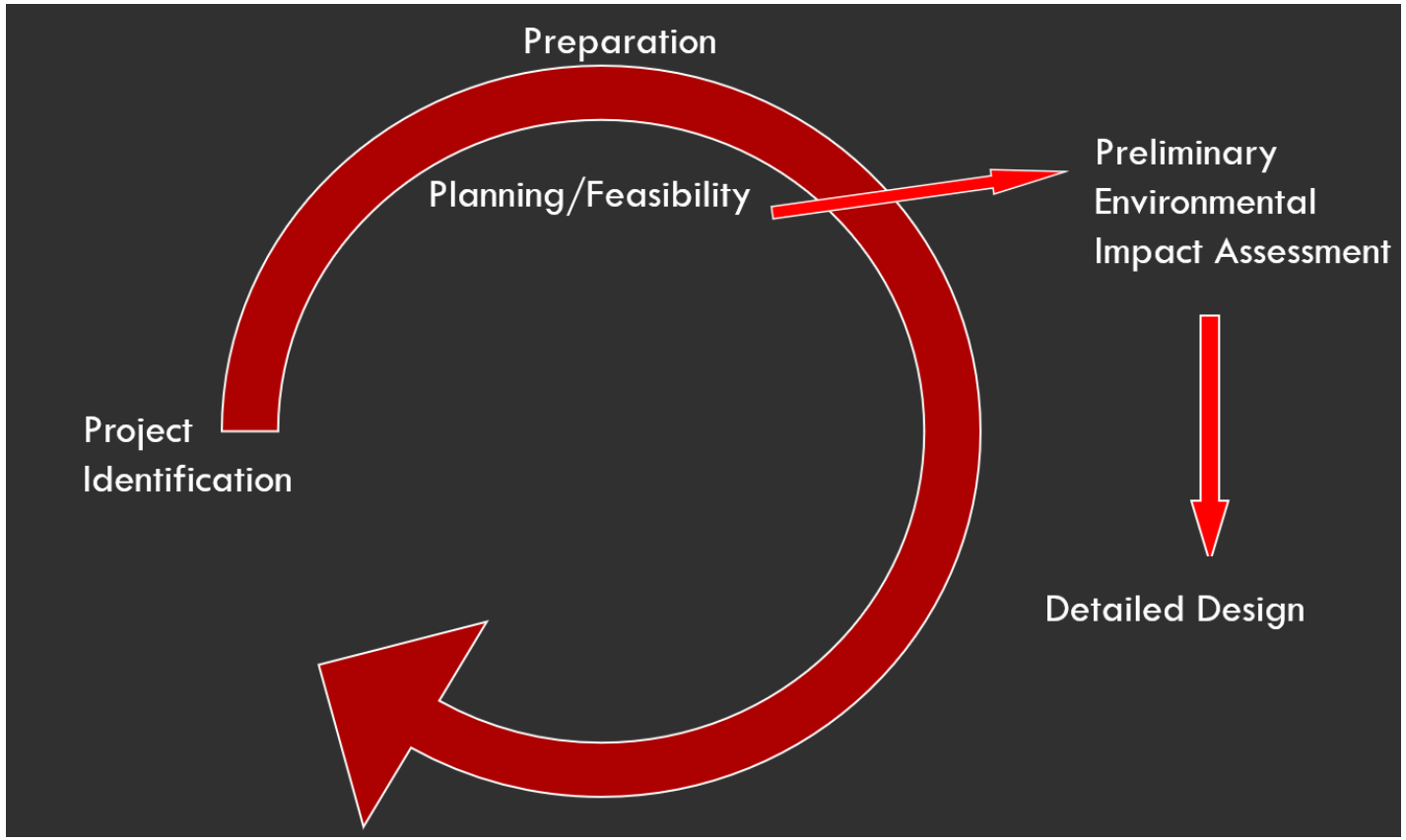
C5:ENVIRONMENTAL REGULATIONS: EMP

- An EMP is a site-specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment and comply with environmental legislation. The components of EMP are,
  - Summary of impacts
  - Description of mitigation measures
  - Description of monitoring program
  - Institutional arrangements, including training
  - Implementation schedule and reporting procedures
  - Cost estimates and sources of funds

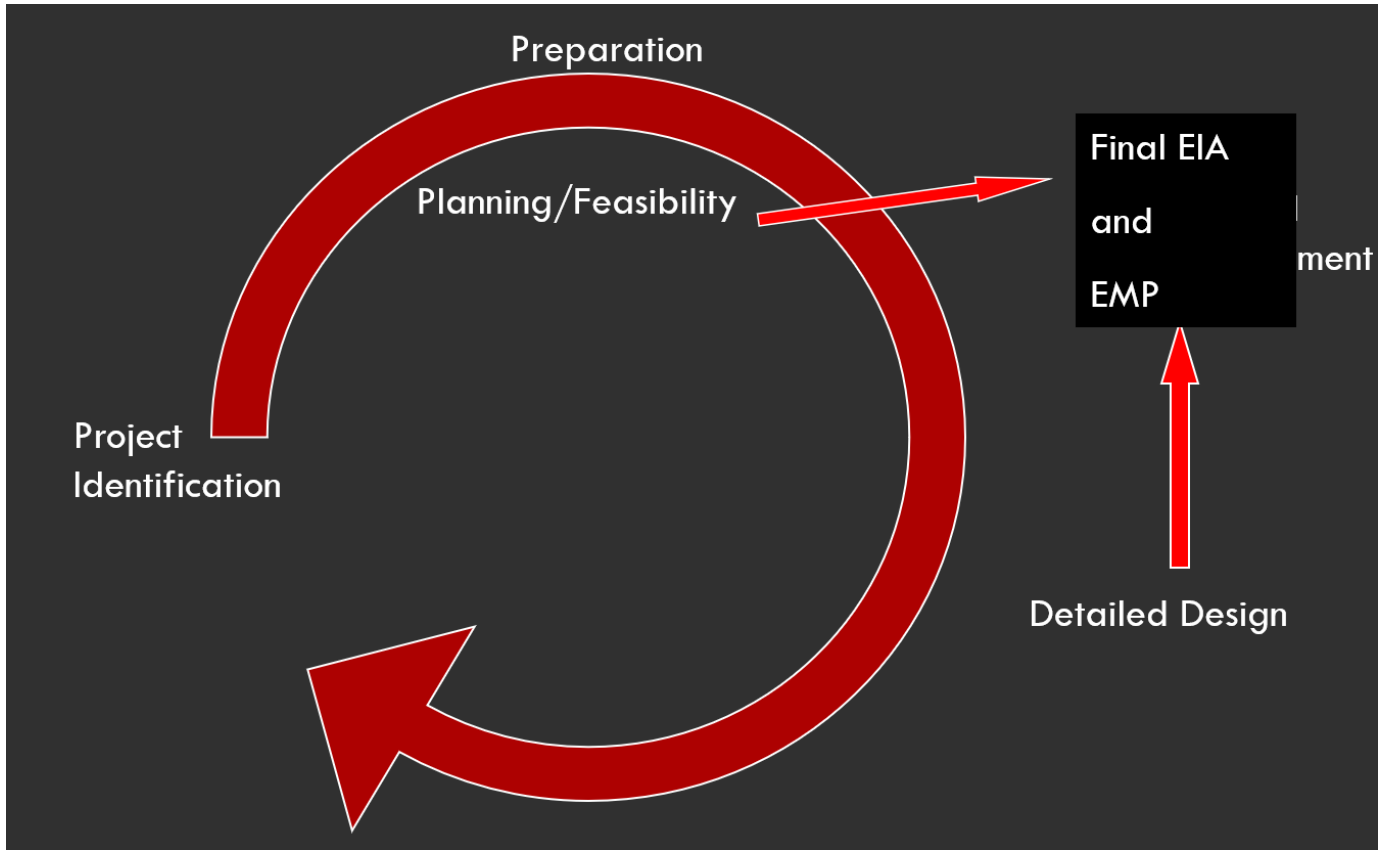
C5:ENVIRONMENTAL REGULATIONS: EMP – STANDARD PRACTICE



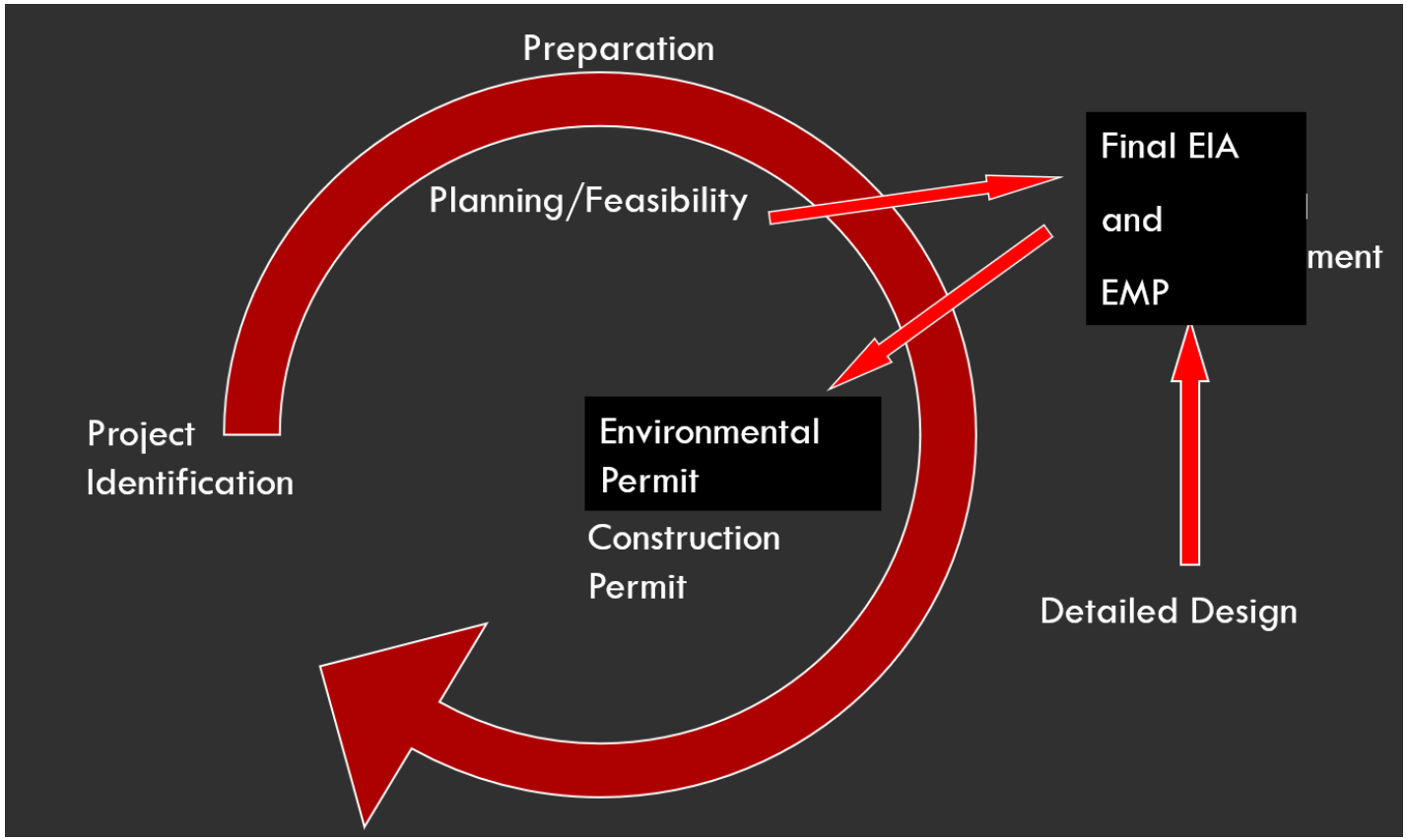
C5:ENVIRONMENTAL REGULATIONS: EMP – STANDARD PRACTICE



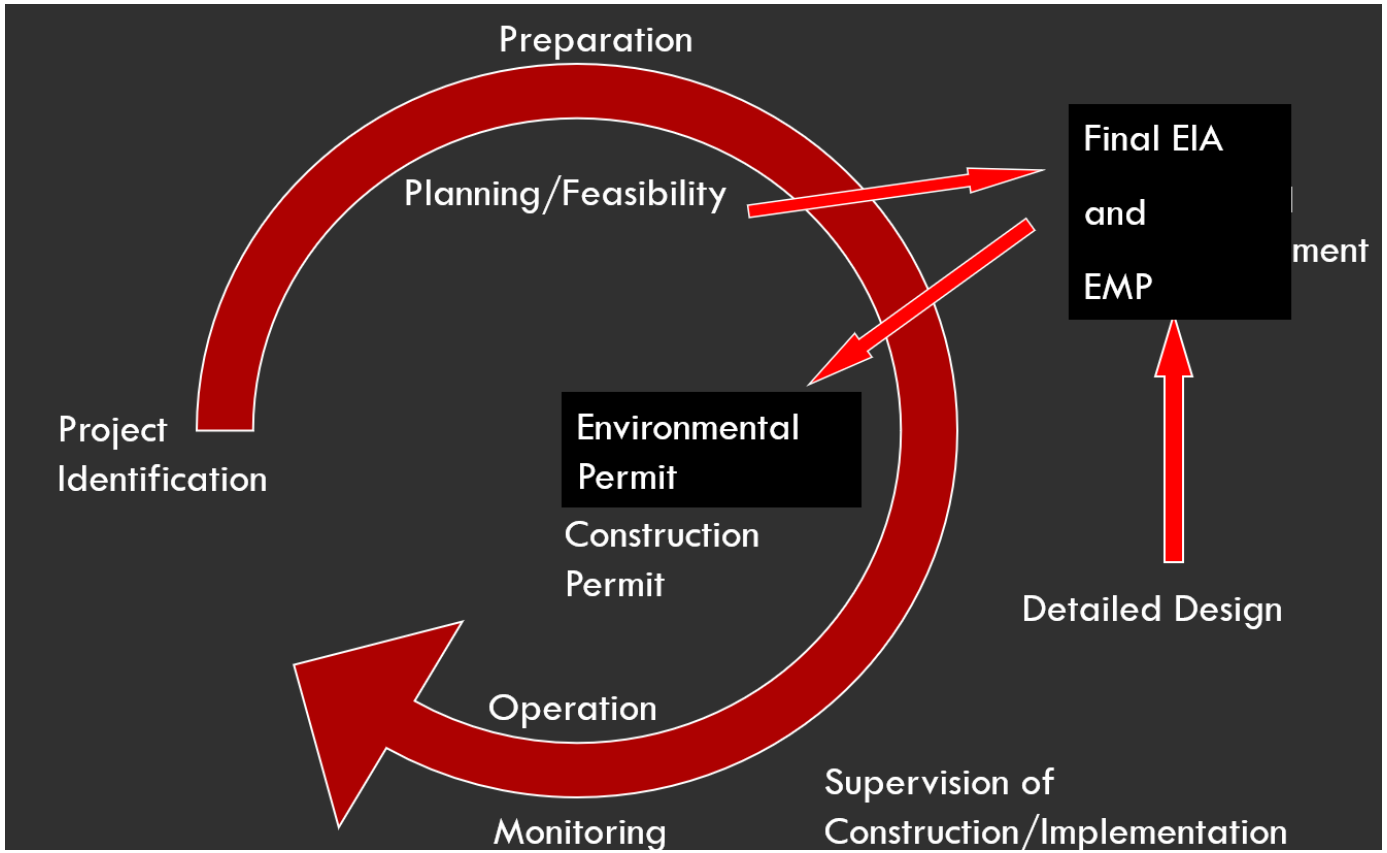
C5:ENVIRONMENTAL REGULATIONS: EMP – STANDARD PRACTICE



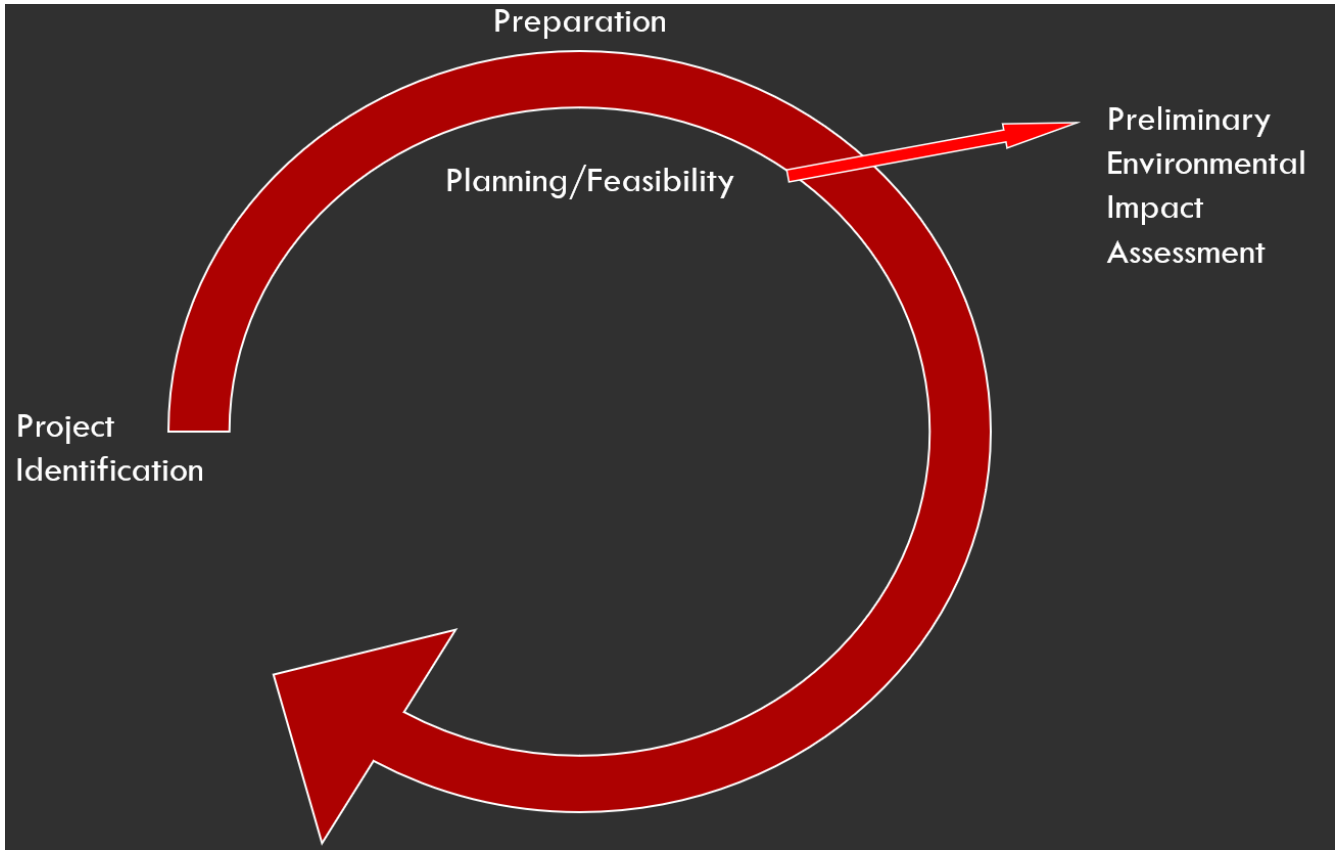
C5:ENVIRONMENTAL REGULATIONS: EMP – STANDARD PRACTICE



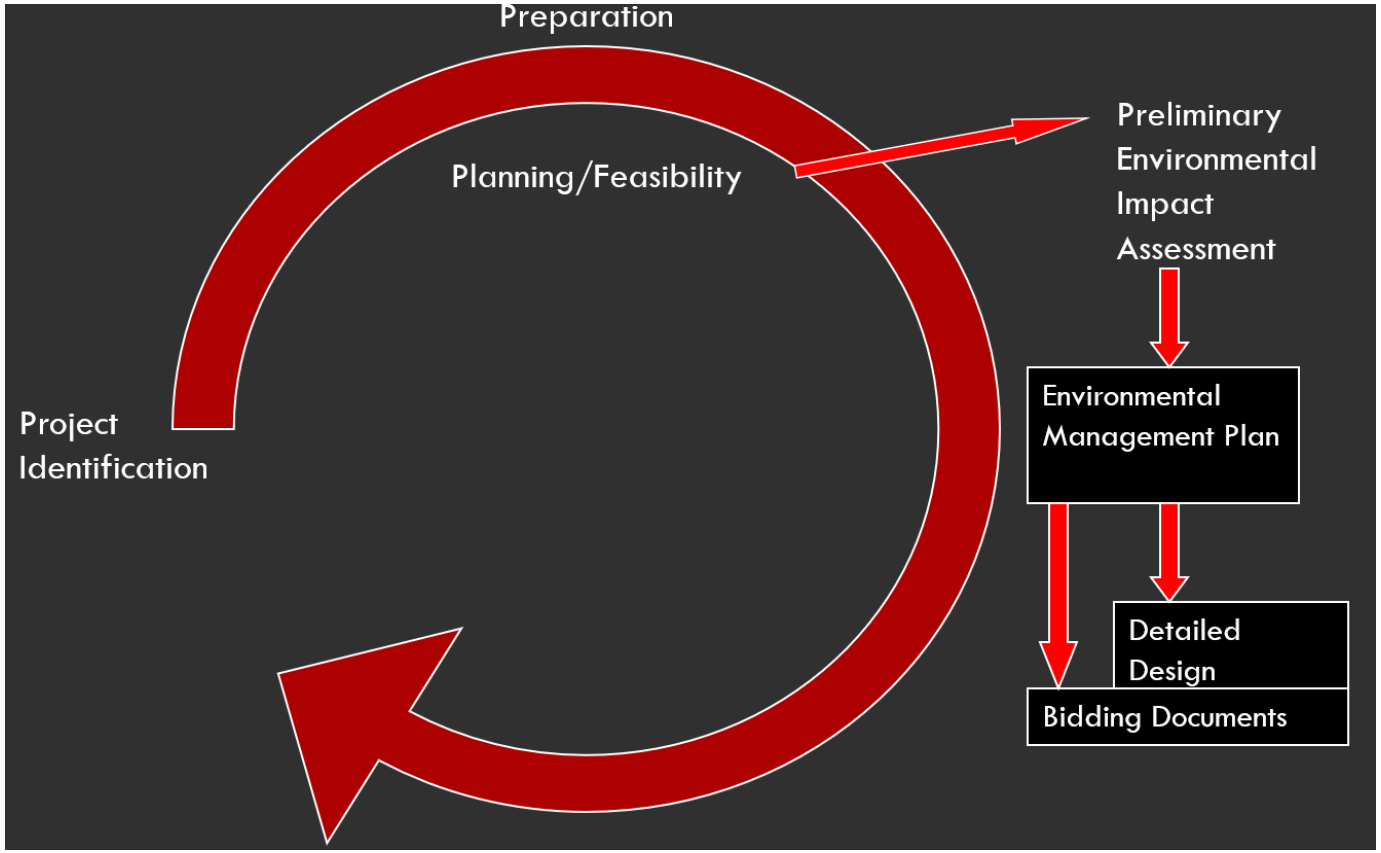
C5:ENVIRONMENTAL REGULATIONS: EMP – STANDARD PRACTICE



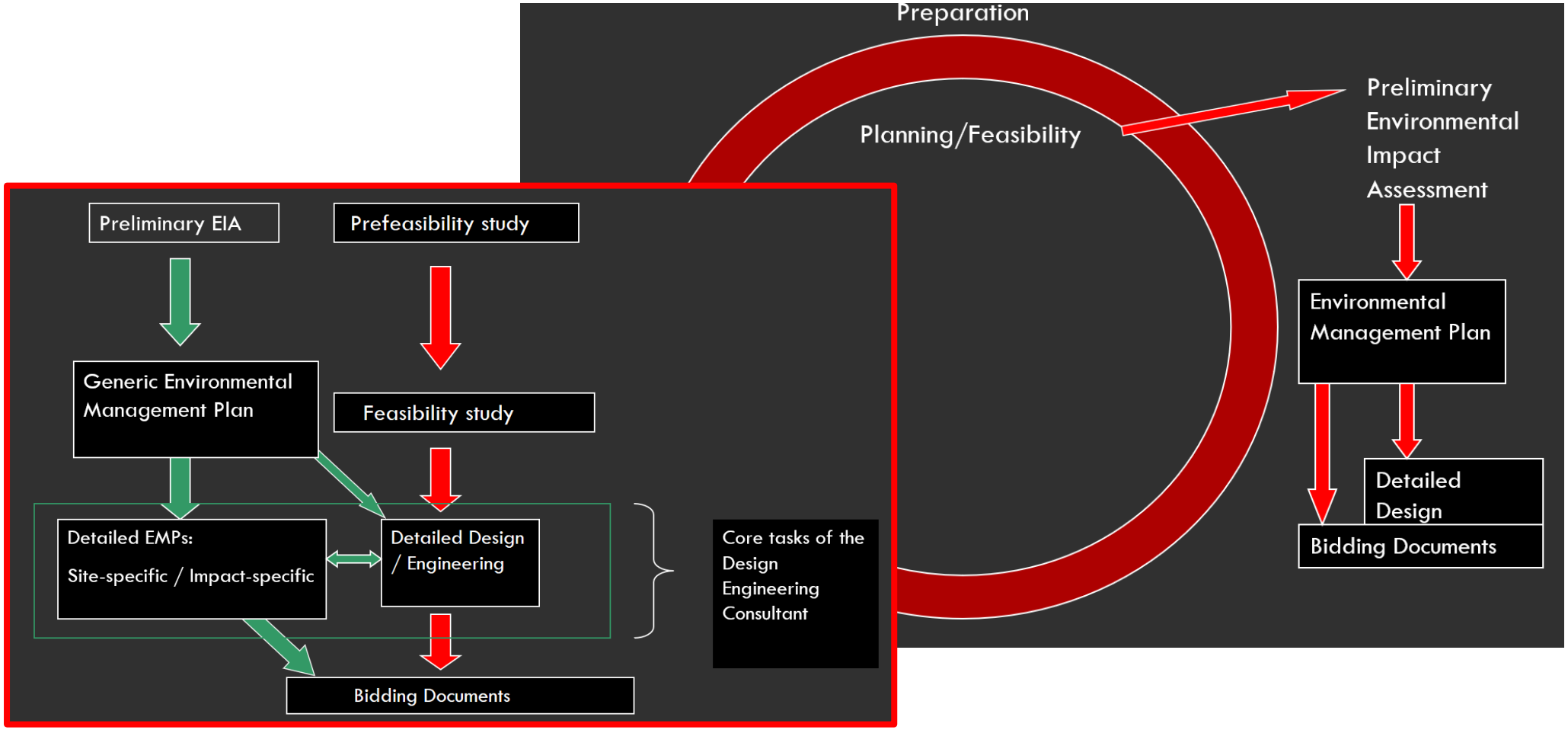
C5:ENVIRONMENTAL REGULATIONS: EMP – BETTER INTEGRATION



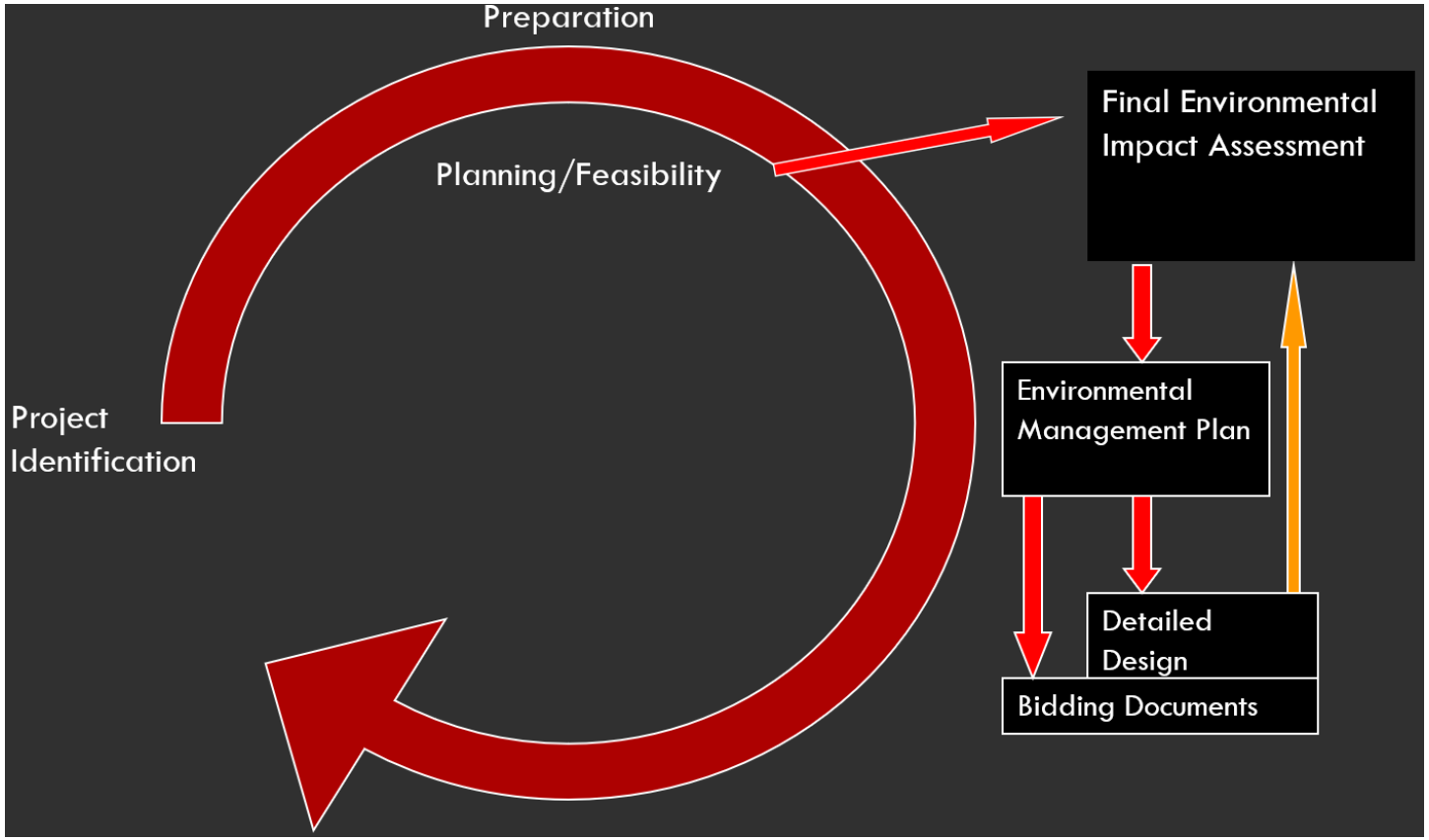
C5:ENVIRONMENTAL REGULATIONS: EMP – BETTER INTEGRATION



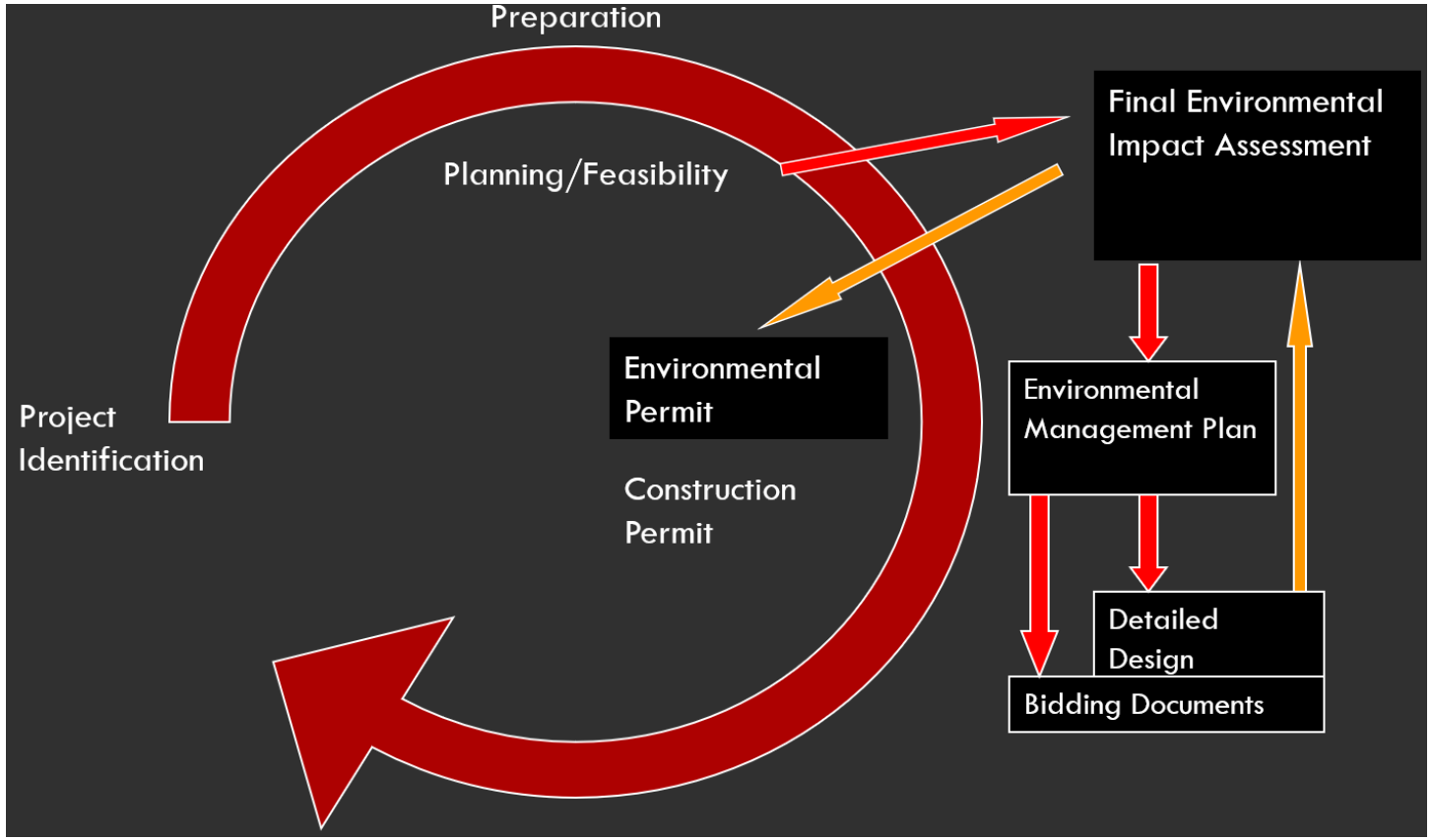
C5:ENVIRONMENTAL REGULATIONS: EMP – BETTER INTEGRATION



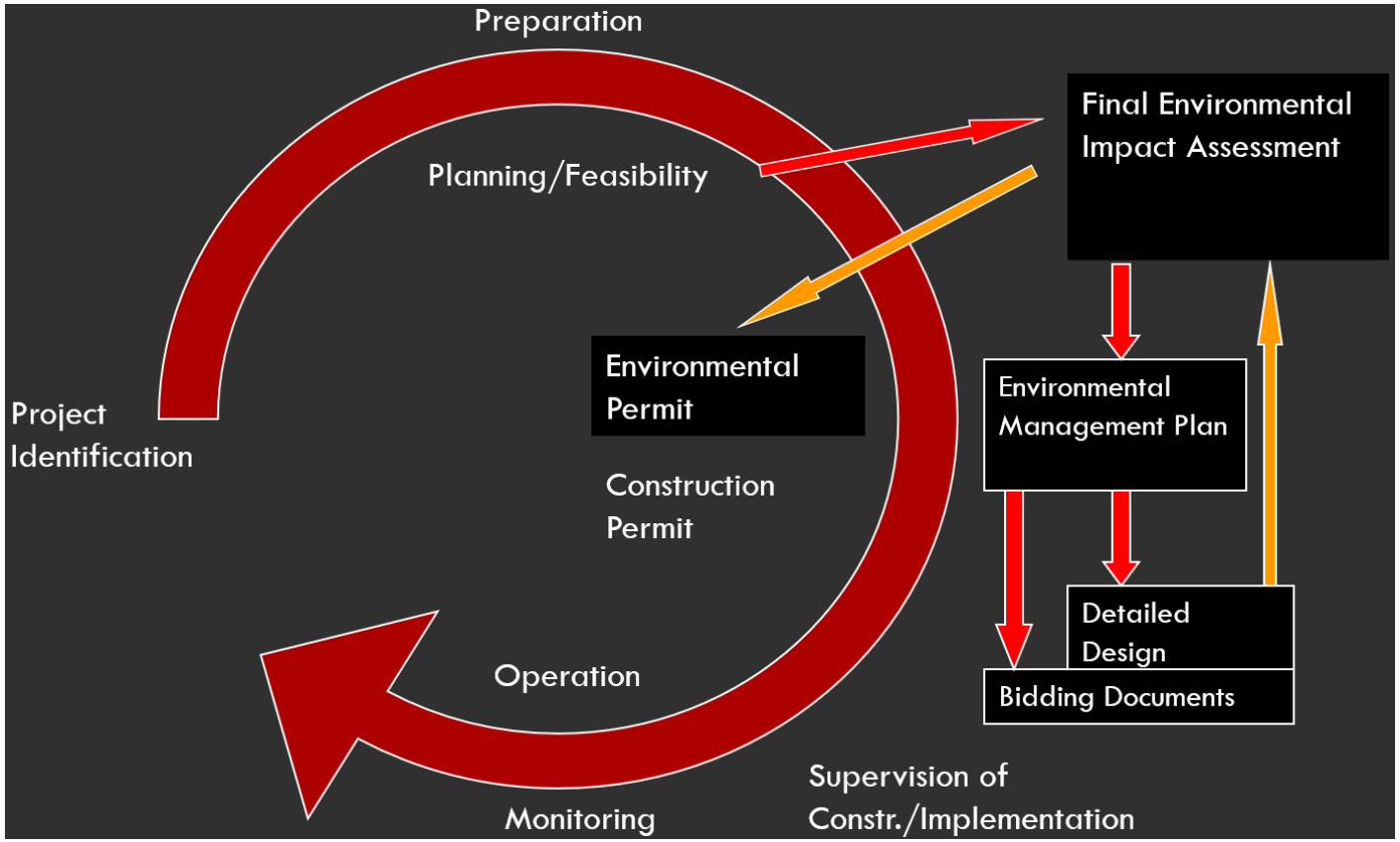
C5:ENVIRONMENTAL REGULATIONS: EMP – BETTER INTEGRATION



C5:ENVIRONMENTAL REGULATIONS: EMP – BETTER INTEGRATION



C5:ENVIRONMENTAL REGULATIONS: EMP – BETTER INTEGRATION



C6:CASE DISCUSSION

Case: **BP and the Deepwater Horizon Disaster of 2010**

Preparation Questions:

1. Why did the Deepwater Horizon disaster happen? How did a company known for being a relatively good corporate citizen become in involved in what many argue is the nation's worst environmental disaster?

Clue: Time pressure, Unethical behaviour, Poor communication, Ignoring Environmental Consequence etc.

2. How the Deepwater Horizon disaster could have been prevented (or at least mitigated).