Playing with Ratios[1]

Anil Seth

Ratios will tell the full measure of meaning, if you have enough of them.
~ Unknown

In any of your Project, have you ever experienced that applying right ratio at right time provides right understanding and this is always taken as a welcome step. However the ratios can also create misunderstandings,

How to handle ratios to estimate the Project?

Many of us live on thumb rules or create certain rules like what I found in one of the interesting student paper by Janette Chea [1].The ratios are there to make our self ,comfortable, these are always to be backed by findings or working logic. E.g. if we are working for EPC (Engineering, Procurement & Construction) lump sum estimate, the general goby is –

E: P: C ~10:60:30.

Some of you may react that this is not always true. Well, these are thumb rules getting converted in to real scenarios after execution and eventually coming as Work Break down Structure in *Tenders to bid*. This Engineering "10" can also be broken down into other goals like:

A) Engineering: Project Support~70:30
B) Project Engineering~10-12%

Process Engineering~5-7%

Mechanical Engineering ~8-13%

Electrical Engineering ~7-9%

Instrumentation Engineering ~7-10%

Piping Engineering ~20-28%

Civil /Structural/Arch Engineering ~20-26%

Is this right! …..Again it's an oil & gas perception based on scope of work.

[1] How to cite this article: Seth, A. (2019). Playing with Ratios. *PM World Journal*, Vol. VIII, Issue IV (May)

Another interesting way of utilizing the ratios is the engineering bottoms up approach. This follows a logical methodology wherein the primary discipline calculates the efforts and rest is bottoms roll up:

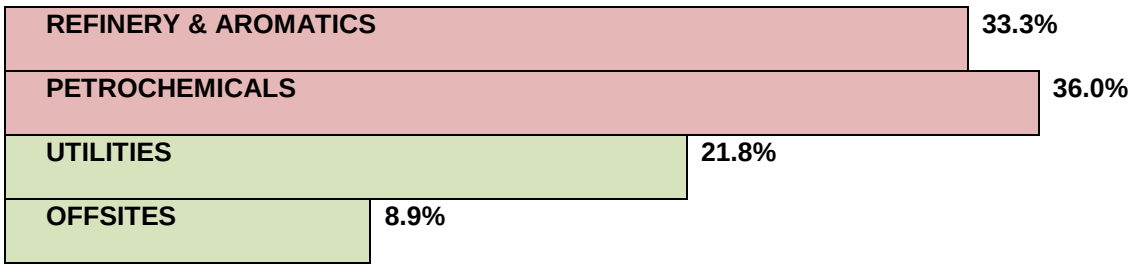
A. Identify the primary discipline.
B. Workout the estimate based on certain factors (like Plant capacity/Equipment Count/Area foot print etc.).
C. Divide the estimate with universal ratio (derived and modified to use through historical database) to arrive at overall estimate required.
D. Modify the overall as per RISK reviewed i.e. addition /deletion due to event/estimate contingency.

Those in engineering services are very much familiar with Front-End Loading [FEL2 or FEL3], in the majority of projects for FEL2 estimation needs many Project Managers factor their engineering from total installed cost (TIC). Incase somebody requires a mature understanding a [2]paper by Melissa C. Matthews is a good read, the focus of this paper is to look at specific practices that are used to create FEL 2 estimates and determine the benefits and tradeoffs of using detailed information and techniques.

While reviewing one of the scopes for Refinery/Petrochemical/Tankage/Jetty/Pipeline Complex, it was found that the ratio of contribution by Refinery/Petrochemical/Offsites was almost same:

UNITS	100.0%
REFINERY & AROMATICS	33.3%
PETROCHEMICALS	36.0%
UTILITIES & OFFSITES	30.7%

This cannot be applied universally; a further narrowing this can also provide the following result:



Further:

CDU, Crude Distillation & Naptha Stabilizer	5.0%	
SGP, Saturates Gas Plant	1.4%	
NHT, Naphtha Hydrotreater & Splitter	1.1%	
ISOM, C5 Isomerization	1.5%	
KHT, Kerosene Hydrotreater	1.0%	
HDT, Diesel Hydrotreater	1.3%	
RDS, Atm. Resid Hydrotreater	4.4%	
RFCC, Resid Fluid Cat Cracker	4.5%	
ULCT, Unsat LPG Chemical Treater	0.7%	
GHT, RFCC Gasoline Hydrotreater	1.5%	
RFCC FGT, RFCC Flue Gas Treatment	0.1%	
MTBE	1.5%	
CCR, Aromizer	2.7%	
Aromatic Complex	6.6%	
REFINERY & AROMATICS		**33.3%**

Ratios are perceptions; these are required to be tuned as per experience. One of the examples is utilizing the ratios to parametrically calculate the Total Installation Cost of the Project.

The Project Expected Engineering Cost can be different for Licensed Unit, Open Art system, Jetty or Tank farm. Various companies develop constants to be used for estimating the Cost; the requirement can be expressed as:

Project Expected Engineering Cost=β X Number of tagged Equipment's X Working factor

β = 100 to 3200 [this is based on the stage of project to be executed, i.e. FEL0/1/2 &3]

Working factor is the individual company's average working cost/hr or an hourly rate.

DISCIPLINE	Total %	FEL2 %	FEL3 %
TOTAL	**100.0**	**100.0**	**100.0**
ENGINEERING	**74.0**	**73.8**	**74.0**
Process	23.9	41	20.9
Process Graphics	5.6	2.99	6.1
HSE	1.0	2.35	0.8
Piping	14.0	4.73	15.7
Pipelines	0.9	2.01	0.7
Mechanical	9.7	8.9	9.8
Civil Structural	6.8	1.89	7.7
Electrical	3.5	2.21	3.7
Control Systems	8.1	6.66	8.4
Marine	0.3	0.8	0.2
Power	0.3	0.26	0.3
SUPPORT	**26.0**	**26.2**	**26.0**
Project Management	8.27	10.8	7.8
Engineering Management	0	0	0.0
Construction Management	0.7	0.59	0.8
Project Controls	5.37	6.09	5.2
Estimation	2.04	2.31	2.0
Procurement	2.3	0.53	2.6
Contract Management	0	0	0.0
Document Control	2.64	1.9	2.8
Project Administration	1.61	1.33	1.7
Information Management	1.37	1.6	1.3
Quality Assurance	0.55	0.53	0.6
Project Business Services	1.12	0.53	1.2

For EPC Contractor this is only a 2 % contributor, the major contributor is either equipment cost or construction cost.

Many companies also venture into studies type of work; this requires quantifying the estimates in project and may also require bankable feasibility report, one of the typical ratios utilized for estimating such work is:

Discipline Contribution in Studies	**%**
Process Technology + Safety [HSE in design]	79%
Mechanical	4%
Civil/Structural/Architectural	4%
Piping	8%
Electrical	3%
Instrumentation	3%
A) Engineering	70%
Project Management (Inc. Engg. Management, Admin, Invoicing, IT & Quality)	25%
Project Controls	10%
Estimation	51%
Documentation	4%
Procurement	10%
Construction Management	0%
Contracting	0%
B) Project Support	27%
C) Subject Matter Expert (SME) Support	3%
Total A+B+C	100%

Again the A:B:C :: 70:27:03 ratio is not firm, this is dependent on the configuration conceptualized by the Project Managers. There are various factors like:

- Starting with less skilled (lower labor rate intrinsic) team being supported by SMEs or highly skilled team without SMEs support

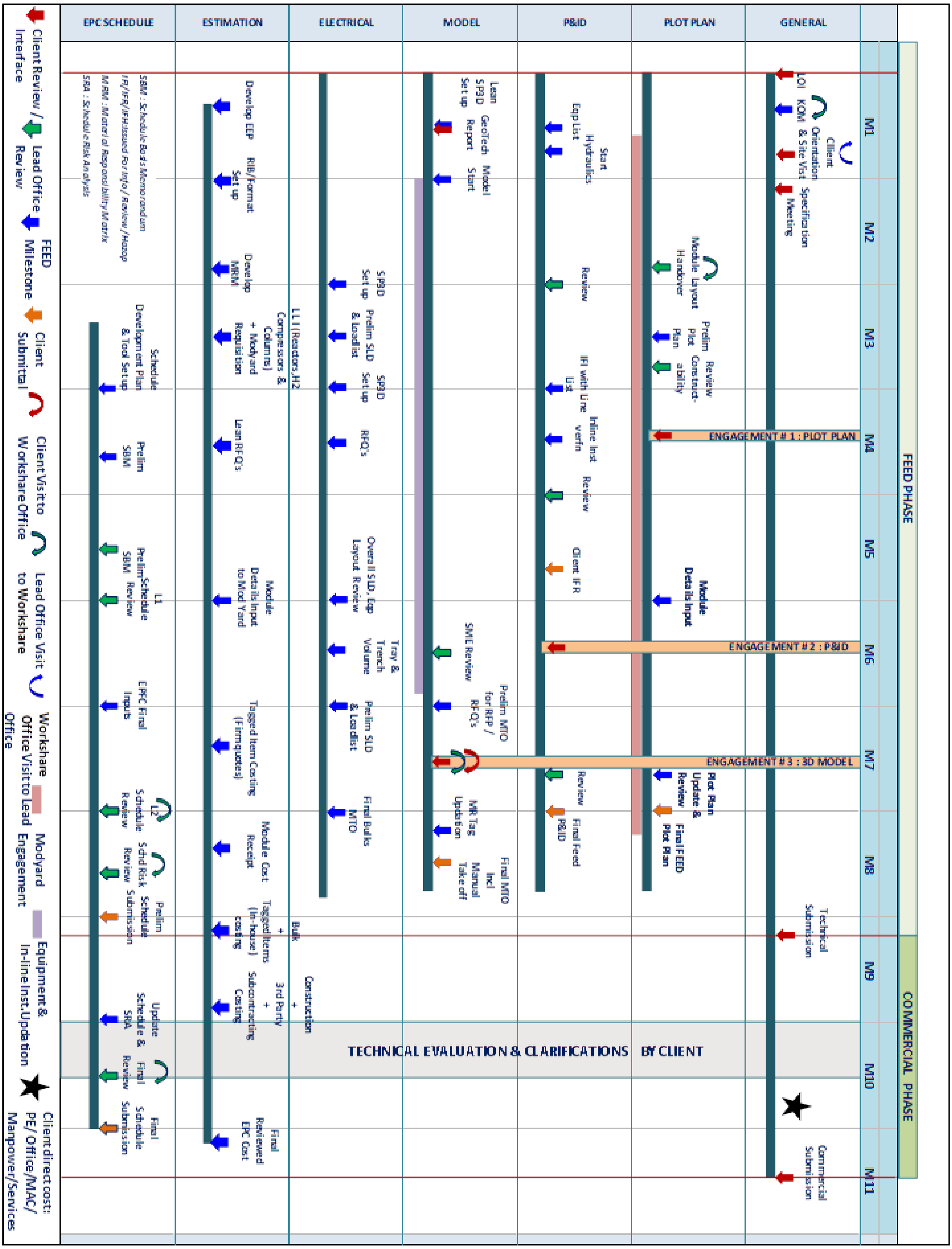
- For Process Technology type report instead of Project Manager keeping Study Manager from Engineering Management

- For budgetary quotations of Licensed/Process/Commercial unit, certain companies involve Procurement representatives or follow in-house data of Estimation group

It is not incorrect to state that the ratios are also dependent on how execution strategies are conceived during proposal engineering.

With strategies we all start thinking it's a bulky book with number of formats or procedures to follow; you may be partly correct however most successful strategies are those which can be zeroed in one page or table and ratios are further tuned upon these strategies.

In Proposal Engineering it is chicken and egg story for execution strategies and ratios, one of the strategies we devolved is illustrated through one page. We will throw more light in various upcoming commentaries later, till then we are providing one of the strategies below which we successfully utilized in Proposal Engineering and it is a ONE PAGER STRATEGY APPROACH.


GENERAL
PLOT PLAN
P&ID
MODEL
ELECTRICAL
ESTIMATION
EPC SCHEDULE
M1
M2
M3
M4
M5
M6
M7
M8
M9
M10
M11
FEED PHASE
COMMERCIAL PHASE
ENGAGEMENT # 1 : PLOT PLAN
ENGAGEMENT # 2 : P&ID
ENGAGEMENT # 3 : 3D MODEL
TECHNICAL EVALUATION & CLARIFICATIONS BY CLIENT
Client Review / Interface
Lead Office Review
FEED Milestone
Client Submittal
Client Visit to Workshare Office
Lead Office Visit to Workshare
Workshare Office Visit to Lead Office
Modyard Engagement
Equipment & In-line Inst. Updation
Client direct cost: PE/ Office/MAC/ Manpower/Services

This discussion or use of ratios and their significance is an endless discussion and we can go on and on of various practices or scenarios. If any of the reader further wants to discuss or deliberate the ratios and their significance can reach me at anil.seth@fluor.com. Let's end this article with a lovely quote:

> *They who are of the opinion that Ratio will do everything, may very well be suspected to do everything for Ratio.*
>
> *~ Unknown*

[1] Exploring Event Projects Cancellation through the Multi-Attribute Decision Making Models

[2] Accuracy of FEL 2 Estimates in Process Plants

About the Author

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Mr. Anil Seth is working as Project Manager in Fluor's Indian office at Gurgaon. Fluor Daniel India Private Limited (Fluor India) provides a full range of engineering, design, procurement, and construction management services to Indian and overseas clients. Fluor India is an established quality provider of engineering, procurement, construction management (EPC) and project management services for Fluor's energy and chemicals, power, mining, and industrial projects, and is a key support office for Fluor facilities located in North America, Africa, the Middle East, Europe, and Asia Pacific

Earlier to Fluor, was in Larsen & Toubro Ltd. at Faridabad, India and managing the Project Engineering Manager Portfolio for hydrocarbon projects. Before joining Larsen & Toubro Engineering and construction division he has worked for Indian Petrochemicals Corporation Limited. He holds B.E. degree with Honors in CHEMICAL Engineering from Panjab University Chandigarh India and has also done Diploma in Environmental Management. He is certified for Harvard Manage Mentor and specializes in Building High Performance cross functional Task Force as well as Converting Breakeven Projects to Profitable scenario. He can be reached at anilshivani99@gmail.com or Anil.Seth@Fluor.com

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