Unified Model For Phasing Of Manpower Requirement In Oil Company

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ABSTRACT: The study started by first developing an organizational structure for the manpower system. Attempt was made to show how manpower system should be structured as a basis for efficient management and matching of skill development to needs. Having developed the organizational structure for the manpower system, number of skilled personnel were estimated and filled into the system by time phasing according to manpower demand. The phasing process is vital for the efficient development and deployment of required skills in any industrial set-up such as petroleum refinery.

Index Terms: Manpower system, manpower demand, matching of skill development, estimate of personnel, engineers and scientist, technical and craft skill, time phasing.

1.0 INTRODUCTION

Modern engineering activities at all stages depend largely on skilled manpower. The estimation of skill requirement is a relatively new field in most developing countries. Many projects are undertaken in developing countries without adequate prior knowledge of the type and qualities of skills required and how those skills are to be phased in the project. The result has often been disastrous, large investment is undertaken without adequate provision of kills for operation and maintenance of plant. Careful manpower planning and phasing in advance of major project can advert some of the difficulties. Phasing of manpower requirements in oil refining plants require thorough familiarization with the possible technologies of the project. Without such familiarization, it is difficult to understand the implications of the types of skills required and mode of producing them. The study started by first acquainting myself with a structure of an oil company (refining plant) and processes used in production, then data was collected from the existing plants visited. At each plant I had interview with top management as well as workers on the shop floor. Gathering the necessary data has therefore been quite difficult. However, I feel reasonably confident that all the major types of skills have been identified together with an estimate of the quantities required. Of course, the number of personnel required for each skill and for the plant and auxiliary services required. My own estimate of the quantities of each type of skill that would be required and phased for operation of Nigeria plant of selected capacity will be strongly influenced by the pattern that exist in the south Africa and Brazil because I believe that experience in those two countries is much likely to be reflected in Nigeria than the experience in other developed countries. The objective of the study is to show how to phase-in the manpower requirements with the construction and the commissioning of various units of the oil refining plant. This phasing process is vital for efficient development and deployment of the required skills. Manpower planning and phasing involves the following steps

(i) The estimation of the types and quantities of skills required over a chosen period

(ii) The assessment of the quantities of skills available from various sources to partly justify the established need.

(iii) The planning of training to produce shortfalls that may occur.

(iv) The development of trained persons in appropriate occupations that would permit effective utilization of acquired skills.

2.0 LITERATURE REVIEW

It is apparent that manpower estimation at the project level is very important in a developing country if any realistic advanced planning is to be done to produce at least some of the skills required before the project is put into operation. The manning of plant is determined not strictly on efficiency as established by careful industrial engineering analysis but in many cases the manning is strongly affected by Trade Union Activities. There used to be a plant in India which the manning is nearly double the estimated need and this is mainly due to Trade Union conflicts. The manpower utilization policy of a government effects very considerably the manning of a plant in the public sector. Almost all firms regard their manning data as strictly confidential. Technological secretiveness is a major obstacle to obtaining manpower data. Unido urges that “Information on the manpower requirement of specific production processes should be more widely disseminated than it is at present”. The quality and nature of raw material affect the choice and design of production processes while in turn are affected by the capacity of the plant. The degree of automation to be employed is affected by various cost consideration and the level of technological characteristics of the plants environment. The type and quantity of skills that would be needed in the Nigerian plant when established cannot be significantly different from what the technology demands, hence a study of manpower pattern in other countries can provide a useful guide as to what range of skills and the number of each type that would be required in Nigeria.

3.0 BACKGROUND INFORMATION

3.1 Developing an Organizational Structure for the Manpower System

It is necessary to develop an organizational structure for manpower system and to develop some criteria for grading various posts, this will make manpower phasing easy and realistic. In reality, this will require job evaluation to determine the work load for a given post or skills so as to determine how many hands are needed. It is obvious that this is not a job for short thesis. What can be done is to develop the basic principles for getting this sort of work done in details and then to fill in the number very roughly

from studies of various plants. So the plan is to first obtain an overall manpower estimate, develop some organizational structure that will break up the overall manning into broad groups of skills at the managerial, supervisory and worker's level. The estimate for overall global manning figure should largely depend on the labour productivity. For a non-existent plant, one can only assume a certain productivity level taking into account the general level of labour productivity now existing and expected over the plan period. In Europe, the labour productivity in similar plants varies between 200 and 300 tons per-year, while in India, it is less than 100. It is preferred to assume some value intermediate between the two extremes.

3.2 Overall Estimate of "In Works Manager"

Assuming a labour productivity of 150 tons for 400,000 bpsd refining plant "in works" manpower would be 6,000 personnel. Allowing another 1,000 personnel for administration, the total would be about 7,000 men. For a developing country, this is a tight number, but it is really not too bad because in India, it is readily admitted that with good planning, the public sector plants could have been manned with 8,000 men "in works" at the 400,000 bpsd refining plant instead of about 11,000 men which was actually obtained in most of the plants. Indian manpower figures are high partly because of the practice of providing helpers to skilled workers. As a rule, most skilled workers demand that a helper should be provided to carry his tool box and another to hold job piece and so on. This practice is not recommended. South Africa is producing an average of 400,000 bpsd with 5,900 men The main interest here is on the "in works" personnel; therefore, emphasis is on the 6,000 personnel. They are tentatively distributed as follows

5% Engineers/Managers
15% Technicians
45% Skilled
25% Semi-Skilled/General Labour
10% "in works" office staff

The percentage suggested for engineers, technicians and skilled workers are rather high for two reasons

(i) To allow for sophisticated processes
(ii) To ensure that high caliber personnel are available to absorb skills at the initial stages of the plant

It is estimated that the following types of engineers / technologist are required: mechanical, electrical, chemical, instrument, petroleum, industrial/production, civil/structural and chemists. Among all, the first three are the largest number. Nigeria now produces more mechanical, electrical and civil engineers, after the engineers, the next classes of technical personnel are technicians and operatives. The technicians are diploma holders. Some of the operatives are highly skilled personnel trained on the job. The largest single groups of personnel are those who are responsible for repairs and maintenance of machinery and equipment. The major skills are: fitters/machinists, electricians, blacksmiths, fabricators, carpenters, welders etc.

3.3 Management Structure

An important aspect of a good manpower planning and phasing is the definition of the span of responsibility of the chief executive, the subdivision of the total management process into functional responsibilities or activities under senior management processes in the establishment of the formal inter- relations. The aim to develop an overall management organization chart is to illustrate general pattern of activities and organization levels. The Organizational frame work and the individuals occupying pivoted positions are both crucial to the effectiveness of the management.

Role of the Chief Executive

It is assumed that the Nigerian National Petroleum Corporation (NNPC) board of directors will appoint an individual to head the petroleum refinery. In South Africa such an individual has been designated at various times as managing director, resident director or general manager. The distinction has been made that the MD or RD has wider powers by virtue of being on the board. The title of GM is preferred because it sounds less pompous and more oriented towards getting things done. He will be responsible for the general management of the entire enterprise by interpreting the policy laid by NNPC. The GM will be assisted by the top management both in the general administration and at the works organization followed by the Deputy General Manager (DGM) who shall be next in rank and status to GM. He will be responsible for works organization. In some organization, the man is often called general superintendent (GS)

Administrative Departments

The intention here is not to be concerned with these other departments which are purely of administrative nature. Other position of authority are shown in the figure 3.0 and 3.1 below

Departmentalization

The next step is to identify the works department listing the various activities scattered all over the plant and integrating them into relevant groups to form the department. The process of grouping depends on several factors such as choice of technology, similarity of process, similarity of products, geographical location of facilities, the pattern of supervision and the coordination at all levels etc. For example, should crude distillation unit be with the stabilizer and Naphtha splitters or each separate, should Naphtha desulfurizer be with catalytic reforming unit and kerosene hydrotreater? etc. Should maintenance of transport equipment be assigned to departmental manager or completely be centralized? Should only the electrical maintenance be centralized while mechanical is decentralized or vice versa? The permutation and combination can be almost infinite.

Divisional structure for the works manager

Here we group certain processes or activities under a works manager

(i) WM crude handling & distillation - WM(C&D)
(ii) WM naphtha desulfurizer & catalytic reformer WM(N&C)
(iii) WM gas plant/catalytic cracking - WM(G&C)
(iv) WM general utilities etc. - WM(GU)
(v) Chief mechanical engineer - CME
(vi) Chief electrical engineer - CEE

(vii) Chief chemical service - CCS
(viii) Chief production planning and control - CPP & C
(ix) WM refined product depot - WM(RPD)

3.4 Estimate of technical personnel

The preceding paragraphs dealt with the structure of the manpower system. Knowing the expected manpower need, an attempt was made to outline a programme for phasing it up. The major technical personnel in a typical oil refining plant are professional engineers and scientist, technicians and craftsmen. The engineers and scientist are mainly the managerial and technological positions, the technicians are mainly in supervising positions in operation and maintenance, the craftsmen are employed in maintenance positions. There are large numbers of persons in operation who are trained on the job after acquiring a good basic education. The discussion in this chapter for manpower problem has been confided to the "in works" personnel.

Table 3 – 1
Managerial and Supervisory Personnel

DGM	1
GS	2
WM	8
M	33
AM	28
SUBTOTAL	72

Supervisory	
GF	71
Foremen	313
AF	111
SUBTOTAL	495
TOTAL	567

It is envisaged that all managerial personnel, general foremen (GF) and foremen are to be engineers. The initial heavy weighting of engineers is to facilitate rapid acquisition of technical know-how, so that in the interim many graduate engineers move up to higher positions after they must have been thoroughly familiar with the routine operations.

3.5 Estimate of engineers and scientists

In the foregoing section, an estimate of managerial and supervisory personnel was given without differentiating between their professional and educational background. It should be noted that apart from engineers, who are employed in technical positions, such persons have been designated as technologists.

3.6 Estimate of the probable Shortfall

Nigeria now has over 85 universities, all of which are offering courses in science and technology. Civil, mechanical and electrical engineering are offered in all of them. The output of these universities should be considered enough for manpower requirements.Therefore securing adequate number of qualified personnel in the three engineering disciplines is not likely to be a problem. All that would be required is to give graduate practical training relevant to the project.

Table 3 -3
Estimate of diploma technicians

Mechanical	350
Electrical	250
Chemical	250
Others	100
	950

3.7 Estimate of craft skill for Maintenance

In this section estimates are given for skills which are indispensable for maintenance work. These skills are usually acquired through formal apprenticeship or training together with the experience on the job. Without adequate availability and utilization of these skills industries will grind to a halt. The numbers given are not definitive but representative

3.8 Skilled manpower estimates for the construction phase

The amount of work at the construction of a 400, 000 bspd refining plant is massive and goes on for several years, anything from three to five years. Considering the magnitude of work involved, it has been estimated that about 20 – 25 million man days would be required. No doubt the man – days would depend on the level of mechanization. The average number of personnel to be employed would depend on phasing and could be about 10,000 on daily employment if the work is to be completed in three years about 5,000 for a 4 -year completion time.

4.0 PROPOSED METHODOLOGY

4.1 Time – Phasing of Manpower Requirements

In chapter 3, estimates were given of various types and quantities of manpower required. It is apparent that various skills cannot all be recruited, trained and deployed at one point in time. The question therefore arises as to how these men are to be made available. This clearly involves the construction programme of the plant and the commission sequence of the various plant units. The construction of modern large-scale industrial project is a complex affair, so complex that special techniques such as CPM and PERT have been developed for planning construction sequence. In this study, it has not been possible to have access to a well programmed construction sequence for petroleum refining plant possible for single individual to develop such a detailed program in a short time. What has been developed is a rough estimate to indicate how an actual program might look like. The construction sequence of petroleum refining plant could be done in a number of ways. For instance, it may be thought desirable to construct the whole plant such that units are commissioned within a few months or weeks of each other. This is usually the case when it is intended that the plant should supply all the inputs to its various units within itself right from the start. In this situation, the construction programme is timed such that the distillation unit, stabilizer, naphtha splitters, naphtha desulfurizer is to be commissioned along with alkylatic plant, vacuum unit, kerosene hydrotreater, delayed cooking unit and gas plant. The difference between the start-up times for the distillation unit (gasification plant), hydrocarbons and co-products conversion including the production of petrochemical feedstock and products

pipelines etc. could be several months. The choice of construction programme should not be taken more than five years, it could be three years. The period assumed are five years because development projects in developing countries are usually characterized with immeasurable delays in project execution.

4.2 Need for phase demand of Manpower

The major advantage of staggered construction and commissioning sequences is really to stagger the demand for manpower so that their supply and training can be phased with consequent reduction of manpower bottleneck. Hence the construction chart is a valuable guide as to how the manpower system might be phased with construction schedules and commissioning of the units. The actual construction workers are the responsibilities of the contractors and equipment suppliers. The study is mainly concerned with the manning of various units when in operation. The following phasing procedures is recommended: the manager of the units and certain key supervisory personnel such as general foreman should be appointed for each plant unit when the construction is at stage (say halfway through) when the installation of the machinery is about to start. This would ensure that the manager of a plant unit and his top maintenance officers are available to watch the installation of equipment so that they know the details of their location and general configuration. It should be recalled that in chapter 3, the organization of plant maintenance places their responsibility for assigned maintenance on the department manager. When a plant unit is commissioned, half of the labour force should be in position. During the first six months, they are oriented or trained in a series of what might be called “dry runs” before actual round the clock production operation begins. The manning should remain at this level until the unit is producing at about slightly above half capacity. It is estimated that this should occur at about 20 months from start-up. At this stage, labour force should be increased to three-quarter of the full strength and again to remain so until the plant unit achieves about three-quarters of its full capacity. The final one-quarter of the labour force should be point-loaded as shown in the developed time phasing. This procedure might avoid unnecessary over manning and resulting indiscipline and sloppy work habits. Thus, manpower system is phased with the build-up of the level of the output. It is not known that there is any standard way of doing this phasing so the arrangement suggested here is somewhat arbitrary but in a method that appears workable and efficient which could be developed further.

5.0 PHASING OPERATION

The result of the developed phasing operation is shown in table 4-1 to 4-3. Table 4-1 shows the distribution of engineers and technicians by plant or departments while table 4-2 shows their distribution by demand according to the commissioning procedure outlined earlier. Table 4-3 shows the corresponding distribution of craft-men. The program that has been developed is intended to illustrate how a typical manpower schedule for an industrial project might be worked out. There is nothing definitive about, it is not claimed to be the only way out, and it is far better than current practice in Nigeria. It is absolutely essential that any manpower planner must ensure that trained men (personnel) are available to occupy posts as they become vacant or created. For the oil refining plant, it is encouraging that Nigeria already has some engineers with experience. Some of these engineers should be selected to join the design team from onset. Every effort should be made to avoid a situation where a trained person returns to find he has nothing to do for a whole year or more. A returning trainee or student should be assigned to a job in less than three months.

Expatriates

It is apparent that quite a few expatriates will be employed during the construction period and in production operations when plant units are commissioned. At start-up, there will be experienced expatriate personnel to be provided by the technical partners or suppliers of equipment to man certain key posts. It should be clearly agreed that these men shall train Nigerians to take over in all phases of operation efficiently and effectively in the shortest time possible. Nigerians should be groomed to operate the plant with minimum supervision from the technical partners within two years from the start-up. At the commissioning stage as many as 300 experts on operation and maintenance might be trained. A trained Nigeria should be assigned as an understudy to each of them. The GM should be a Nigerian from the onset with the expert adviser. There should be two DGM, one expatriate and a Nigerian understudy. All the “works managers” should be occupied by expatriates for the first three years and they should be phased out thereafter over a period of 20 months. The post of departmental managers and their assistants should be held by Nigerians from the onset with the provision that a selected team of advisers from the technical partners will guide and supervise the operation of the key sections. The terms of the working agreement should be so carefully balanced as to permit the smooth running of the plant. The agreement on training with the technical partners should be carefully related to the sort of training program to be given. It should be possible to effect a complete transfer of operation and maintenance to Nigerians within seven years from start up as shown in tables 4-1, 4-2 and 4-3. Under suitable working conditions, Nigerians are hard workers and it is certain that the challenge of technology will be met at all stages of Nigerian’s development.

6.0 CONCLUSION AND RECOMMENDATION

The estimate of skill requirement is still a relatively new field in most developing countries. Accurate statistics and other information on manpower are hard to come by as information on demographic economic and technological factors effect manpower supply and demand. From the forgoing, it is envisaged that the technical manpower planning and phasing developed here, if implemented would bring efficient development and deployment of required skills in any industrial set-up such as oil refining company. It will also reduce the over or under-supply of skills with resulting waste in either case thereby improving the productivity of the company.

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ORGANIZATIONAL CHART

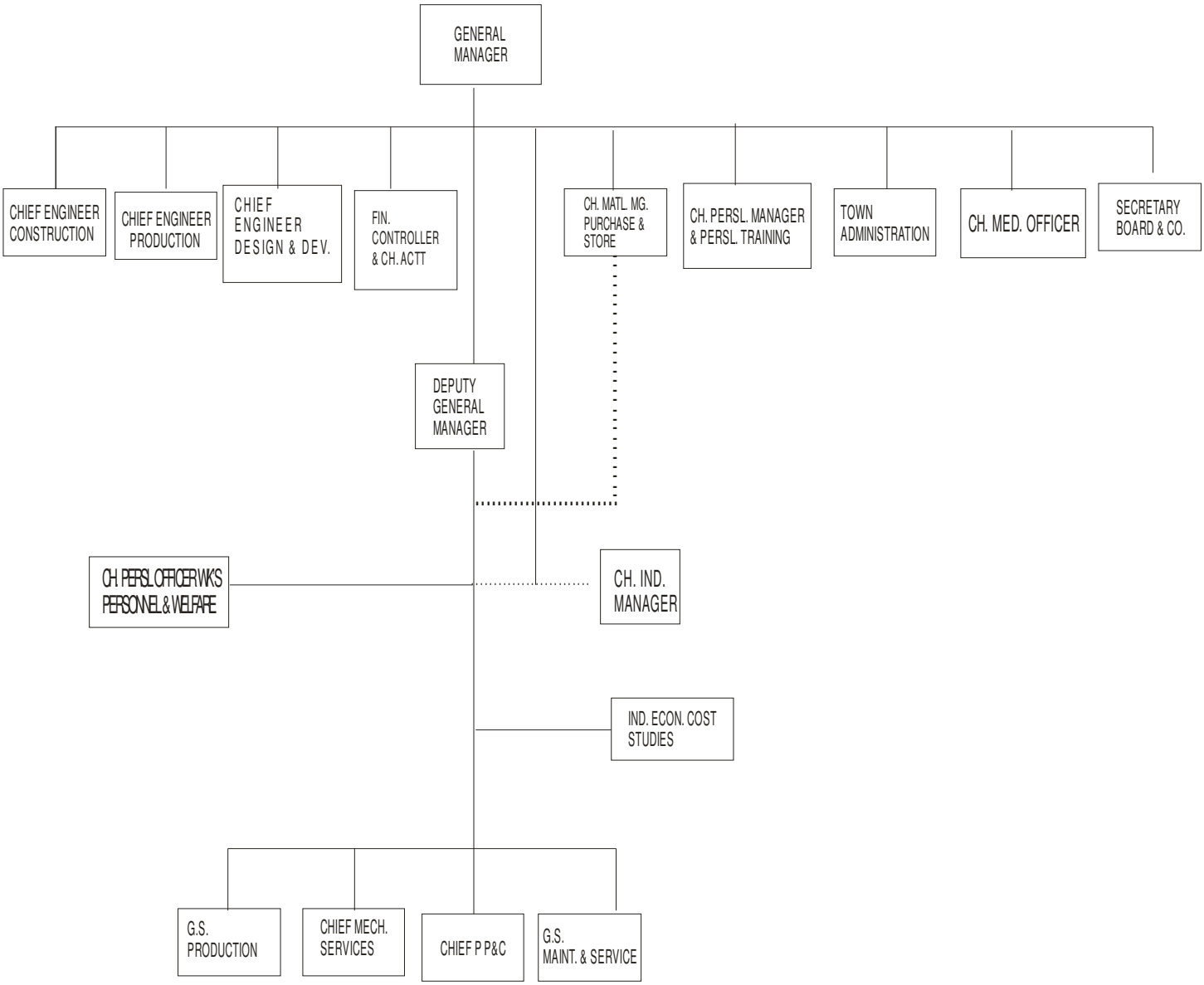

FIGURE 3.0, GENERAL MANAGERS CHAIN OF COMMAND

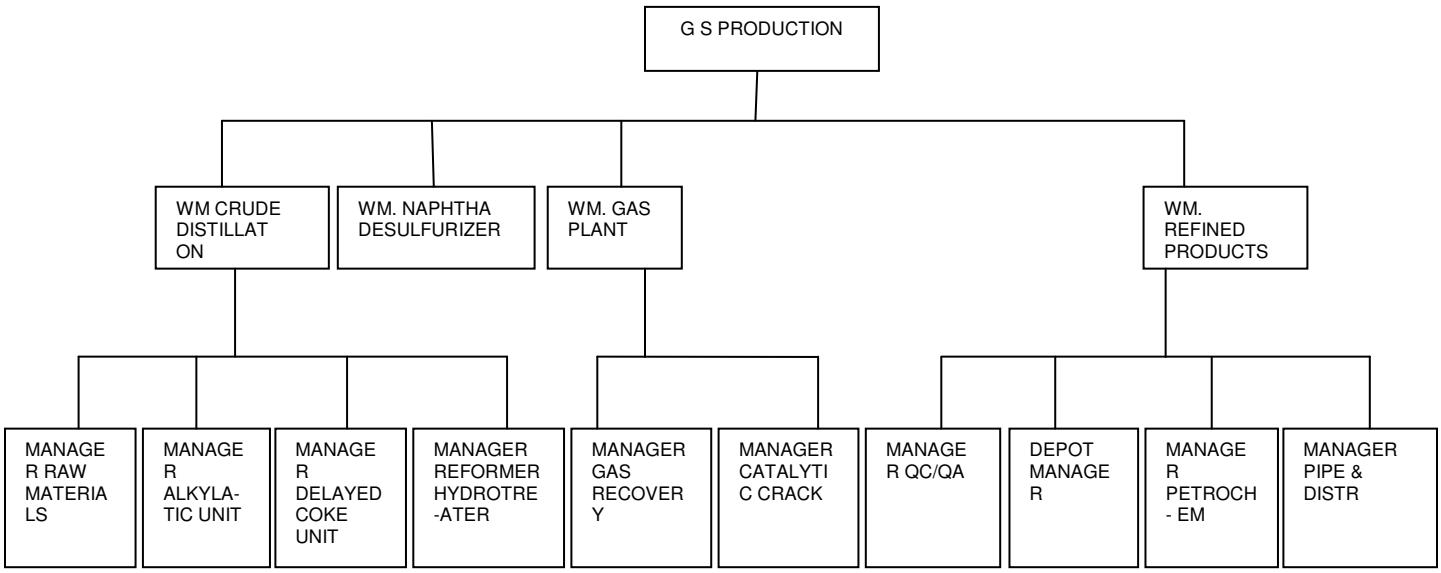

Figure 3-1

G.S PRODUCTION

Table 3 – 2
Estimate of engineers and scientists (in works)

Operations	Maintenance and Services		Technologist	Total
Eng(Mech)	30	70	62	162
Eng(Elect)	40	40	10	90
Eng(Civil)	-	10	-	10
Eng(Ind)	-	-	10	10
Eng(Telecom)	-	8	-	8
Eng(Chem)	-	10	20	30
Eng(Petrol)	20	-	-	20
		Subtotal		330
Chemists	-	-	20	20
Physicists	-	-	10	10
Statisticians	-	-	3	3
System Analyst	-	3	3	
		Total		366

TABLE 4–1 DISTRIBUTION OF MANAGERS, TECHNOLOGISTS AND TECHNICIANS BY DEPARTMENT

	CIVIL WORKS	WATER SUPPLY SYSTEM	ELECTRICAL POWER PLANT	STRUCTURAL PLANT PROCESS	CRUDE RECEIVING UNIT	CRUDE DISTILL. GASIFICATION	NAPTHA DESULF PURIFICATION	CATALYTIC CRACKING-HYDRO	FLUID COKER ETC	CENTRAL MECH. MNTC	CENTRAL ELECT. MNTC	CHEMICAL PROCCESSING	TANK FARM AND PIPELINE	PLANT SERVICES	RAW MATERIALS & STOCKING	TRG TECH CENTRE	PRODUCTION PLAN & DESIGN DEV	QC/QA	CENTRAL MECH WORKSHOP	CHEMICAL WORK UP	MARINE SERVICE
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
ENGINEERS																					
Wm												1(ch)				1(m)	1(p)				
M	1(c)	1(m)	2(e)	1(m)	1(m)	2(mi)	2(ch)	1 (m)	1 (m)	5(m)	5(e)	4(ch)	1(m)	5 (1, 2	1(m)	3(1,2, 3)	3(6)	2 (ch)	1 (m)	1 (m)	1 (m)
Am		1(m)	2(c)	1(ch)		1(ch)	2(ch)	1 (m)	1(ch)	5(m)	5(e)	2(ch)	1(m)	2			5		1 (m)	1 (m)	
Mech	1	2	5	8	6	8	8	5	4	12		2	3	6	2	3	4	1	10	4	4
Elect		1	12	4	2	5	5	5	4		18		2	6	1	2	4		2	4	
Chem		2				20		4	10			15						6			
Fuel			4	2		4							1	3						1	1
Telecom																					3
Civil	1	1												3							1
Ind. Eng																	10				
SCIENTIST																					
Chemists		1				1						10	3								
Physicist												8		4							
Statistician																	3				
System analyst																	3				
TECHNICIANS																					
Mech	3	16	15	40	10	16	10	40	12	35		12	8	75	5		6	2	30	5	2
Elect		6	36	18	2	10	10	10	5		20	10	5	18	4		6	1	28	3	2
Instrument			8											30	3						
Chem												40		30							
Fuel			8	3	2	4								3						3	2
Telecom											35										3
Civil	5													4							1
Ind																			6		
Asst. Chemist		4				5						30									
Asst. Physicsts												25		8							

TABLE 4-2 TIME PHASING OF MANAGERS, TECHNOLOGISTS AND TECHNICIANS

2013	TIME PHASING 2014													TIME PHASING										
	1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12
WM	1(M)											1C							1(M)						
M	3(1,2,3)																		3(1,2)						
AM																			3(1,2)						
TECHNOLOGIST																									
1. MECH																	3								
2. ELECT																									
3. CHEM																									
4. FUEL																									
5. TELECOM																									
6. CIVIL	4																								
7. IND. ENG																									
SCIENTIST																									
8. CHEMISTS																									
9. PHYSICIST																									
10. STATISTICIAN																									
11. SYSTEM ANALYST																									
TECHNICIANS																									
12. MECH																									
13. ELECT																									
14. INSTRUMENT																									
15. CHEM																									
16. FUEL																									
17. TELECOM																									
18. CIVIL																									
19. IND.																									
20. ASST. CHEMIST																									
21. ASST. PHYSICISTS																									

2015	TIME PHASING 2016													TIME PHASING										
	1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12
Wm	1(M)		2(19)									1(M)			1(M)		1(M)			2(M)			1(M)		
M	1(M)			2(CH)								4(1,2)			2(M)		1(M)		2(M)				1(CH)		
Am	3(M)			2(CH)								4(1,2)		19											
Technologist																									
1. Mech														32											
2. Elect														26											
3. Chem														10											
4. Fuel														5											
5. Telecom														2											
6. Civil														4											
7. Ind. Eng														4											
SCIENTIST																									
8. Chemists														5											
9. Physicist														2											
10.statistician														2											
11. System analyst														2											
TECHNICIANS																									
12. Mech														101											
13. Elect														75											
14. Instrument														15											
15. Chem														7											
16. Fuel														6											
17. Telecom														16											
18. Civil														12											
19. Ind.														8											
20. Asst. Chemist														19											
21. Asst. Physicists														16											

2017	TIME PHASING 2018													TIME PHASING										
	1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12
Wm																									
M																									
Am																									
Technologist																									
1. Mech		**34**				**38**													**25**						
2. Elect		**10**				**12**													**13**						
3. Chem		**13**																	**1**						
4. Fuel																			**3**						
5. Telecom																			**2**						
6. Civil																			**2**						
7. Ind. Eng																			**2**						
SCIENTIST																									
8. Chemists		**4**																	**1**						
9. Physicist																			**1**						
10. Statistician																			**1**						
11. System analyst																			**1**						
TECHNICIANS																									
12. Mech		**37**			**80**														**80**						
13. Elect		**13**			**30**														**37**						
14. Instrument																			**3**						
15. Chem		**10**																	**7**						
16. Fuel																			**4**						
17. Telecom																			**8**						
18. Civil																			**6**						
19. Ind.																			**9**						
20. Asst. Chemist		**13**			**2**																				
21. Asst. Physicists																			**9**						

2019 TIME PHASING 2020														TIME PHASING											
	1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12
WM																									
M																									
AM																									
TECHNOLOGIST												10													
1. MECH		12			12	16						6													11
2. ELECT		5			5	14																			5
3. CHEM		6			6	1																			6
4. FUEL						5																			
5. TELECOM						3																			
6. CIVIL						1																			
7. IND. ENG						2																			2
SCIENTIST																									
8. CHEMISTS		4			2	2																			2
9. PHYSICIST						1																			
10. STATISTICIAN						1																			
11. SYSTEM ANALYST						1						20													
TECHNICIANS												15													
12. MECH		37			13	50																			13
13. ELECT		13			6	37																			6
14. INSTRUMENT																									20
15. CHEM		10			20	3																			
16. FUEL						4																			
17. TELECOM						8																			
18. CIVIL						6																			
19. IND.						7																			
20. ASST. CHEMIST		13			5	9						1													5
21. ASST. PHYSICISTS																									

TABLE 4-3
TIME PHASING OF CRAFT SKILLS REQUIREMENTS

2015 TIME PHASING 2016														TIME PHASING											
	1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12
1. Millwright														101											
2.Mech repairman														191											
3.Pipe fitter														8											
4.Blacksmith														6											
5.M/c tool operator														38											
6.Mech (const)														3											
7.Electrician I														83											
8. Electrician II														89											
9. Inst. Mechanic														15											
10. Welder														32											
11.Gas Cutter														49											
12. Driller														43											
13. Carpenter														13											
14. Draftman														4											
15.Telecommechanic																									
16. Bench fitter																									
17.Fabricator																									
18.Fitterstructural														11											
19.Refrg &air cond. Mech														4											
20.Cablejointer														5											
21.Wireman														4											
22.Lineman														5											
23.Teleman														105											
24.Mason														4											
25.Heat treatment														10											
26. Shaping m/c operator														7											
27. Plumber														6											
28.Mech Diesel														13											

2017 TIME PHASING 2018														TIME PHASING											
	1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12
1. Millwright	55					58													27	50					
2.Mech repairman	69					76													80	80					
3.Pipe fitter	5					1													1	4					
4.Blacksmith	10																		5	3					
5.M/c tool operator	164																		83	19					
6.Mech (const)	4																		2	2					
7.Electrician I	35					60													10	30					
8. Electrician II	12																		5	40					
9. Inst. Mechanic	3																		1	5					
10. Welder	30																		15	14					
11.Gas Cutter	32																		26	20					
12. Driller	20																			15					
13. Carpenter	5																		4						
14. Draftman	35																		3						
15.Telecommechanic	3																		18						
16. Bench fitter	5					3													2	5					
17.Fabricator	34																		6	2					
18.Fitterstructural	30																								
19.Refrg &air cond. Mech	25																			10					
20.Cablejointer																				15					
21.Wireman																				16					
22.Lineman																				5					
23.Teleman																				10					
24.Mason																				2					
25.Heat treatment																				32					
26. Shaping m/c operator						10														40					
27. Plumber																				3					
28.Mech Diesel																				5					

2019 TIME PHASING														2020 TIME PHASING											
	1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12
1. Millwright						50						29							27						29
2.Mech repairman						95						12							34						12
3.Pipe fitter						3													1						
4.Blacksmith						2													6						
5.M/c tool operator						18													82						
6.Mech (consta						2													2						
7.Electrician I						40						30							14						30
8. Electrician II						46													7						
9. Inst. Mechanic						6													1						
10. Welder						16						11							18						11
11.Gas Cutter						24						12							19						12
12. Driller						20																			
13. Carpenter						6																			
14. Draftman						2													3						
15.Telecommechanic																			21						
16. Bench fitter																			14						
17.Fabricator																			15						
18.Fitterstructural																			16						
19.Refrg &air cond. Mech						16																			
20.Cablejointer						2																			
21.Wireman						2																			
22.Lineman						2																			
23.Teleman						3																			
24.Mason						51																			
25.Heat treatment						3																			5
26. Shaping m/c operator						5																			
27. Plumber						1																			
28.Mech Diesel						6																			