

Cloud Application for Managing Retail Gas Stations – Introduction to Formation of National Oil Energy Grid

Arvind Ankalikar¹, Dr. S S Mantha²

¹Department of Mechanical Engineering, Sardar Patel College of Engineering, Mumbai 400058, Maharashtra, India

Abstract: This paper is about developing a framework using Cloud Computing technique integrating the operations of retail gas stations. India's dependence on oil imports is very significant with almost 70% crude getting imported. While the crude oil supplies to refinery and the petroleum products from refinery depot and depot to retail stations is tracked well, it is always difficult to ascertain what goes on in the retail gas station itself and the manner in which the products are dispensed. Moreover, energy availability through hydrocarbon based fuel is fairly limited, the retail gas stations, which are at the end of the supply chain need also to be regulated some day in future. Thankfully, we today have technologies such as cloud computing which can be leveraged to first of all manage entire operations of retail gas stations and in turn monitor the way the fuel is dispensed to the vehicles. The framework of cloud based applications have multiple advantages to all the stakeholders at large and this paper attempts to identify those benefits. The framework also identifies broad level functionalities that can be built into the overall framework. Cloud applications are capable of tracking the transactions being processed such as dispensing to vehicles, but also manage other functions such as back office management, maintenance, HR and other features which are essential for running the retail gas station and adding revenue streams.

Keywords: Gas Station, Cloud Applications, Downstream Retail, Oil and Gas, Petrol Pump

1. Introduction

India is heavily dependent on imported crude to meet its domestic energy requirement. For the financial year 2013-14, as per the Ministry of Petroleum and Natural Gas report, the provisional number for domestic crude production was 37.788 MMT while the imports were whopping 189.238 MMT. As the GDP grows, the domestic oil consumption is bound to grow resulting in considerable strain on exchequer even further. These trends are likely to make the entire energy sector become more regulated from consumption stand point. One notable example being step taken by the Government of India to regulate number of LPG cylinders per family. While there is a separate research paper published on optimizing the consumption pattern to get better productive yield from the combustible fuel, this research paper focuses on leveraging Information technology for bringing about effective governance at retail gas stations which will give the government required tool to administer future policies in much more efficient manner. Just to give an example, while the statistics is available on petroleum products produced by Indian refineries, what we are unable to track effectively is the consumption at the end of the distribution chain. This is about capturing data on consumers of petroleum products buying fuel at gas stations and the energy balance of petroleum products distributed from refineries to retail and then to end consumers. Retail gas stations perform several activities which include dispensing oil to consumers (vehicle owners) as well as other activities such as servicing of vehicles as has been observed widely. One of the problems encountered by the gas stations is the dealer commission payout which is not adequate enough for the dealers to make enough margins in this highly risk driven business of handling fuel oil. The petrol dealers and retailers therefore have to create alternative revenue channels such as service stations, maintenance of vehicles,

convenience stores etc. in order to make earn their livelihood. It is therefore apparent that gas stations nowadays look more like a departmental store and less like the olden days shabby looking petrol pump.

India today has almost 48000 gas stations spread across the country and this number is growing every year. The Figure 1 below gives the numbers of Gas Stations in India and the growth over a period of time.

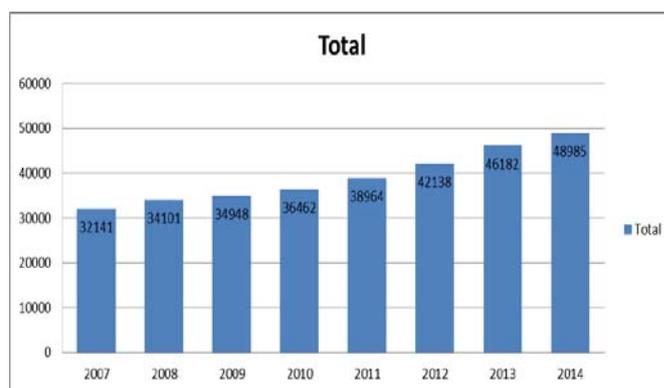


Figure 1: Total Retail Outlets in India

Generally gas stations are of following types:

COCO : Company Owned Company Operated

CODO : Company Owned Dealer Operated

DODO : Dealer Owned Dealer Operated

DOCO : Dealer owned company Operated

It will be interesting to know that most of these gas stations are CODO types.

The dealer margin on the products is generally very thin i.e. approx. 1.4% while the risk they carry is considerable due to very nature of the product being handled through the supply chain. Further it is also important to know that retail Gas Stations

account from approx. 49% of total hydrocarbon fuel energy consumed in the country. The Table 1 “(a)” and “(b)” below gives the details of consumption of fuel based on various industry sectors within India.

Table 1(a): Product-wise Consumption of Petroleum Products (Financial Year-wise)*

S. No	Products	2013-14 '000 MMT	% to Total
A	Light Distillates	47748.61	30.18
1	LPG	16335.5	10.33
2	Motor Spirit	17127.6	10.83
3	Naphtha + NGL	11454.2	7.24
4	Others	2831.31	1.79
B	Middle Distillates	81838.1	51.73
1	SKO	7164.9	4.53
2	ATF	5504.6	3.48
3	HSDO	68368.7	43.22
4	LDO	386.1	0.24
C	Others	413.8	0.26
1	Heavy Ends	28609.89	18.09
2	Furnace Oil	5744.58	3.63
3	LSHS	448.72	0.28
4	Fuel Oil	6193.3	34.66
5	Lubes/Greases	2890.8	1.83
6	Bitumen	4937.7	3.12
7	Petroleum Coke	11651.4	7.37
8	Waxes	259.38	0.16
9	Others	2677.31	1.69
Total Consumption Refinery fuel and		158196.6	-
Losses (RBF)		17867.55	-
Grand Total		176064.15	-

It is therefore very essential to have a systems developed for handling retail gas stations (petrol pumps) to effectively track the activities for better understanding consumption. Moreover as all the gas stations are similar in terms of operations, it is very effective to have cloud architecture for managing multiple gas station with application hosted on single instance in multi-tenancy mode. This paper elaborates the overall solution notwithstanding some of the challenges such as network connectivity, computer literacy etc.

Table 1(b): High Speed Diesel Oil Consumption in India

S. No	Sector	2013-14	
		Cons	% to Total
1	Transport	3203.1	4.69
i)	Road Transport	205.85	0.3
ii)	Aviation	1.23	0
iii)	Shipping	365.21	0.53
iv)	Railways	2630.8	3.85
2	Agriculture	429.24	0.63
3	Power Generation	204.42	0.3
4	Mining & Quarrying	873.12	1.28
5	Manufacture Industry	686.93	1
i)	Iron & Steel (Metallurgy.)	153.83	0.22
ii)	Textile	46.33	0.07
iii)	Cement	124.68	0.18
iv)	Ceramic & Glass	5.5	0.01
v)	Chemicals & Allied	103.38	0.15
vi)	Aluminum	28.19	0.04
vii)	Civil Engineering	68.32	0.1
viii)	Elec./Electronics	26.48	0.04
ix)	Mechanical	70.08	0.1
x)	Fertilizers	14.83	0.02
xi)	Other Consumer &	45.3	0.07
6	Resellers/Retail	61464.81	89.9
7	Miscellaneous	1425.67	2.09
	Total	68287.28	99.88
8	Pvt Imports	81.42	0.12
	Total Consumption	68368.7	100

2. Activities Performed at the Gas Stations

Typical gas station activities involve activities such as:

- Petrol/Diesel dispensing
- Daily stock checking
- Product replenishment by reorder of fuel products
- Maintenance of tanks which is performed periodically
- Maintenance of dispenser machines and pumps
- Maintenance of compressors
- Billing
- Back office operations as needed
- Environment, health and safety reporting

As the margins made on fuel distribution is very thin, most of the gas stations also carry out other associated services such as:

- Car washing and servicing
- Convenience stores of sundry items
- Vehicle repairing facility
- Compressed air facility
- Restaurants attached to the gas stations

The Figure 2 below depicts the activities performed by gas stations. Needless to say that these functions more or less represent an enterprise in miniature, having almost all the corporate functions. Even the transactions carried out in gas stations are not small, and any system of reconciling inventory and accounts can help the gas station to become more effective.

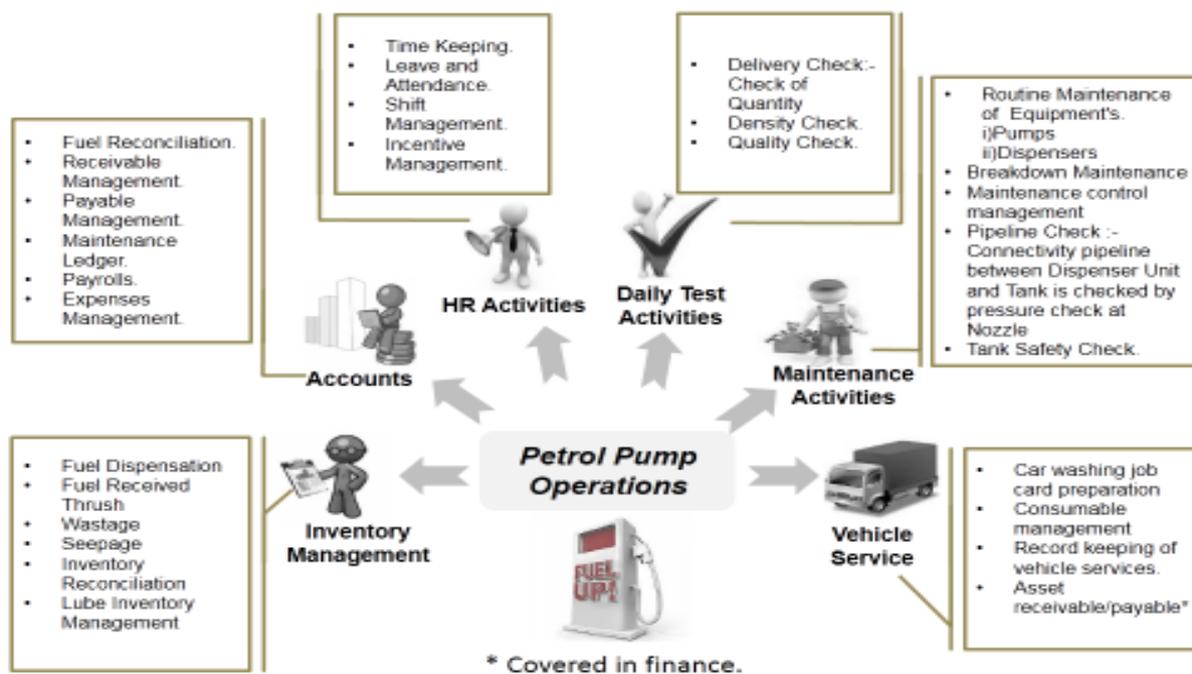


Figure 2: Operations at Gas Stations

Also many times, it is suspected that the gas stations adapt to some malpractices such as fuel adulterations. Any system implementation at gas stations can track such anomalies quite easily bringing in controls which are so essential in managing this very valuable supply chain.

Based on the above activities, it is apparent that to plan the operations and also for the purpose of managing inventory and accounting transactions, the Gas Station operations need implementation of system to take care such activities. Now this poses a challenge as well as an opportunity for the oil companies, as to integrate all their gas stations by providing a robust integrated application for managing the gas station operations can only help them manage supply chain well.

We all are aware that hydrocarbon fuel has a finite availability and a time is not far when we may have to administer strict controls over consumption even to the extent of capturing data of fuel consumed per person or per vehicle.

3. Literature Survey for this Research Report

A detailed literature survey was performed to analyze the data on the number of gas stations in India and the consumption of Motor Gasoline as well as High Speed Diesel Oil in the country. This data was obtained based on the reports published by Ministry of Petroleum and Natural Gas through their notification published yearly.

Apart from this data, a detailed literature survey was conducted to analyze the types of cloud applications and its applicability for various industry sectors. Gas stations operations being very standard and repeatable, is found to be perfect candidate for cloud based systems. The reasons are:

- High numbers
- Identical operations
- Similar functional requirements
- Low margin business with limited ability to invest in infrastructure
- Operations fairly comprehensive needing system support
- Similar report requirements
- Regulated business
- Needing high level of automation due to volume

The solution presented addresses all these aspects as may be noted from below sections.

4. Proposed Cloud Offering for Managing Gas Station Operations

The basic principal of cloud based application is to create an infrastructure which can be sourced by many entities or consumers. The application in itself is developed in such a manner that not only it is replicable, but shares the common code set and common database segregated in a secured manner so that there is no violation of data privacy. The entire application is hosted on a single hardware stack and is made accessible to all the consumers over the internet. There are features such as multi-tenanted architecture which enable several different firms, entities; organizations access the same set of code for processing their business needs. The business processes are common and configurable and can be fine-tuned based on specific needs. Also the workflows are highly configurable and even the looks and feel of transactions screens can be personalized depending on various business needs. The overall architecture of any cloud based application looks as per the schematic Figure 3 given below:

Shared Cloud Principles :: Security & Isolation

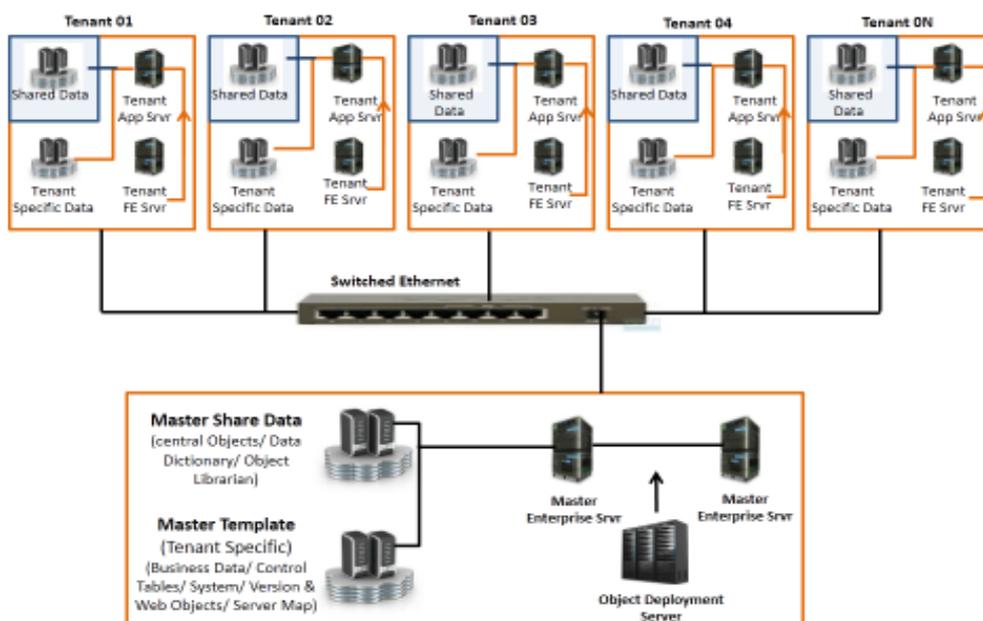


Figure 3: Overall architecture of any cloud based application

Based on the above principles, all the gas stations can actually be accessing a common application set for managing their operations. The application can be fully secured and logically partitioned so that there would be no data privacy violation. The tenant’s apps and front end servers give the flexibility of configuring applications based on the type of operations being managed by the gas station. The following table provides the brief information on various modules applicable for running Cloud infrastructure and applicability to other business lines such as service station and convenience stores. All these modules could be hosted on cloud basis for retail gas stations to avail the functionality for running their day to day operations.

Table 2: Additional Revenue Models adopted by Gas Stations

Modules	Gas Station	Service Station	Convenience Stores
Product Data Management	✓	✗	✓
Inventory Management	✓	✗	✓
Purchase Order Management	✓	✗	✓
Sales Order Management	✓	✓	✓
Work Order Management	✗	✓	✗
Accounts Payable	✓	✓	✓
Accounts Receivable	✓	✓	✓
General Ledger	✓	✓	✓
Fixed Asset Management	✓	✗	✓
Merchandizing	✗	✗	✓
Advance pricing	✗	✗	✓
Integration with Card system	✓	✗	✓
Automated replenishment system	✓	✗	✓
Maintenance Management	✓	✓	✗

One of the biggest advantage of making these applications available on cloud is the retail gas station operators can make payment for the system on “Pay Per Use” basis eliminating need of upfront investment in costly hardware and software.

Also these applications can be maintained centrally without any financial burden to any of the retail gas station operator to incur additional expenses. Moreover the retail gas station operator can track each and every customer by vehicle number enabling generation of reports of fuel dispensed vs replenished, giving accurate tally of inventory as well as financials.

The overall Cloud application will be as per the schema (Figure 4) below:

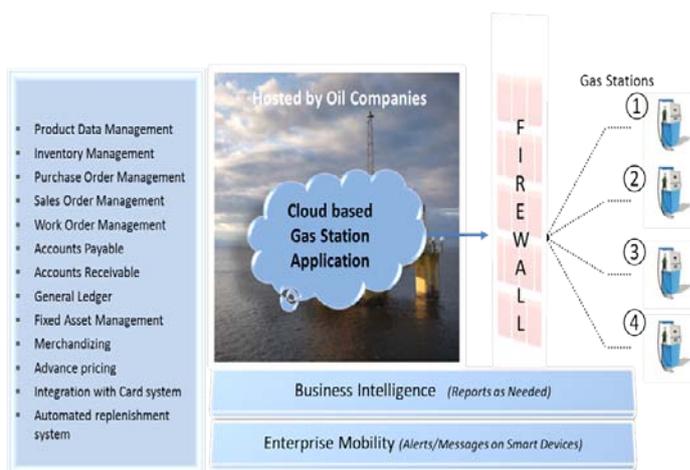


Figure 4: Overall Cloud Application

The above will give immense benefit to not only the gas station owners but also the oil companies.

5. Benefits Derived

The proposed architecture can immensely benefit multiple stakeholders who are part of the entire ecosystem. These

benefits will eventually also help the government to bring in regulations in terms of controlling the consumption of fuel oil by vehicle number if needed, which is so vital for India's economy.

The below table summarizes the benefits:

<i>Benefit to Gas Station Operator</i>	<i>Benefit to Oil Companies</i>
<ul style="list-style-type: none"> • Low cost system for accounting Effective Inventory management <ul style="list-style-type: none"> • Ability to manage expense • Keeping track of all manpower <ul style="list-style-type: none"> • Accurate Payroll processing • Automated reorder point • Easier account reconciliation Ability to accurately assess profits Ability to book service orders on web	<ul style="list-style-type: none"> • Visibility of supply chain • Assessment of dry point status <ul style="list-style-type: none"> • Auto replenishment • Makes adulteration difficult • Better distribution planning

<i>Benefit to Consumers</i>	<i>Benefits to Government</i>
Better quality of Oil Transparency of billing Faster turnaround of billing Web based booking No stock outs	Tracking consumption Cleaner environment due to less adulteration Enforcing regulations is easy

- [5] Running JDE on Shared Cloud White paper, Doc 1543201.1
- [6] Supply Chain Management of Downstream Retail Oil Distribution and Use of Big Data Solution for Computing Energy Balance – Conceptual framework , Journal of Information, Knowledge and Research in Mechanical Engineering
- [7] Supply Chain For Liquids, Out of the box approaches to liquid logistics, By Wally Klatch
- [8] Research Paper by Sartorius K, Eitzen C, Hart J on Examination of the Variables Influencing the Fuel Retail Industry, University of the Witwatersrand, Johannesburg, South Africa

Author Profile



Arvind Ankalikar received the Bachelor of Mechanical Engineering from REC Surat (now NIT, Surat) and of Masters in Management from JBIMS, Mumbai University. Also certified in Advanced Manufacturing and Supply Chain Management from National Institute of Industrial Engineering (NITTE) and has participated in Executive Development program of Ross School Of Management, USA. He is pursuing Ph D in University of Mumbai under the guidance of Dr S S Mantha, Chairman AICTE.

6. Formation of National Energy Grid and Way Forward

It is apparent that hydrocarbon energy, being finite in terms of availability, is depleting rapidly. While there is a fairly robust process exists to track crude oil being supplied to refineries and products being dispatched from refineries to depots and depots to retail station, there is no control whatsoever post retail gas stations when the fuel is dispensed to vehicles. Such Cloud based application is an opportunity for all downstream Oil and Gas companies to provide a platform for all retail gas station operators for managing their business. This will also facilitate creating a proper energy balance across the nation with accurate assessment of fuel available across all the gas station. Moreover this gives an opportunity to create a “National Energy Grid” that can be leveraged for obtaining accurate status of fuel available across the country. Such a grid can then be calibrated based on the industry types, region and if required, quota for restricted use of this vital energy. Also such National Energy Grid can be very vital in the case of defense needs and other government eventualities by accurately assessing availability in the grid.

References

- [1] Indian School of Petroleum, “Downstream Business Process”, August 2007, Final Report
- [2] Indian Petroleum and Natural Gas Statistics
- [3] Success through the continuous innovation, JD Edwards summit – 2013
- [4] Oracle JDE Cloud White Paper, 2013