



PUMP MORE FOR LESS - AN ORDER TO CASH TRANSFORMATION IN OIL PIPELINES

Executive Summary

Our point of view explores avenues for an order-to-cash (O2C) transformation so that oil pipeline companies can pump more crude at a lesser cost, use their existing infrastructure and substantially improve their margins.

The key questions that we seek to address include:

1) How can pipeline companies improve asset utilization while not compromising on pipeline integrity?

- 2) How can they reduce their cost of operations?
- 3) What should they do to cope with technological changes?
- 4) How should they manage a workforce in transition?
- 5) What should they do to retain high levels of customer satisfaction?
- 6) How to manage business growth in volume and complexity?

- 7) How to manage operational challenges more effectively?
- 8) How to sustain organic as well as inorganic growth by developing scalable systems?

We define a broad framework by visualizing what can be done if all third-party pipeline companies come together to provide their services on a single platform such as a virtual marketplace.

Introduction

Pipelines have become an integral mode of transportation for petroleum-related products within and across the countries. In most cases, they are a safe and economical means of transportation. In the United States, there are 2.4 million miles of pipeline, of which 83,000 miles is for crude oil and 63,000 miles for refined products. According to a Pipeline and Gas Journal 2019 survey on worldwide construction, an additional 50,580 miles of pipelines are under construction and 94,773 miles of pipeline are planned, awaiting regulatory approval in the US. In volume terms, an estimated 250 million barrels per month of crude and petroleum products are transported across North America. These pipeline systems are regulated by the National Energy Board to ensure that there

is no unjust discrimination in tolls, service, or facilities.

With many oil pipeline companies in the world running close to practical maximum capacity (after accounting for maintenance, carryover, throughput profile, and mandatory shutdowns) amid variable oil prices, these companies are struggling to improve their margins. On the capacity side, companies such as Enbridge (North America's largest pipeline operator) were consistently apportioning above 40% or higher (pre-Covid) and even in the month of July it was 3% and 7% in August. The Canadian Association of Petroleum Producers has forecast that the supply of crude oil will rise by 39% from now until 2030, and additional infrastructure is needed to handle about 1.5 million bpd to meet growing demand for pipelines. On

the tariff side, pipeline companies have very little control over tariffs as they are usually regulated or are part of long-term contracts that do not change for a few years at a time. This to a large extent, combined with running near full capacity, limits the top line of these companies. There is always pressure on the bottom line because of rising cost of power, manpower costs, and other operational costs.

Operating liquid pipeline systems of such scale and size is a perfect storm of varied constraints which needs to be addressed together. It is important to maintain a fine balance between meeting business objectives, operating with existing network challenges, adhering to regulatory constraints, and satisfactorily meeting customer requirements.

Operational challenges and constraints will vary based on the complexity of pipeline network. (Illustrative list)



Business objectives

Improve asset utilization, reduce operating costs, and manage supply / demand scenarios better



Customer needs

Reduced and if possible predictable transit time, uncontaminated product, delivery in a certain order to refineries



Network challenges

Unplanned maintenance, flow rate constraints, carry over volumes, shut-downs / restarts



Regulatory constraints

Treat all shippers equitably / fairly, maintain pipeline integrity, and adhere to agreed toll structure

Avenues to pump more for less

Improve asset utilization

Even though many pipelines run on full capacity, there is still scope for improving pipeline utilization. Capacity in oil pipelines is not a linear function of flow rate alone. It also depends on several factors such as pump efficiencies, the commodity mix, and network shutdowns. Given that this is a multi-variable problem, the scope for improving capacity can come from one or more of the following avenues:

- 1) Reducing shutdowns
- 2) Improving the ratability
- 3) Identifying the correct logical route to take the volumes through
- 4) Scheduling the crude batches optimally
- 5) Building / optimal utilization of storage units in key choke points
- 6) Optimum use of drag reducing agents
- 7) Better scheduling of maintenance activities
- 8) Identifying the optimum flow rates based on the network design and the type of crude while maintaining pipeline integrity
- 9) Improve the timing of injections (normal as well as tight line) and deliveries (normal as well as tight line) into the network
- 10) Managing storage better
- 11) Identification of the optimal apportionment calculation / logic (what to cut and in which line and how it will affect capacity)

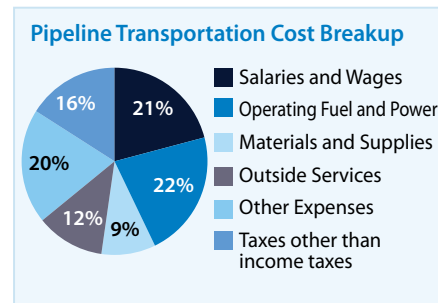
Developing these solutions requires intensive optimization logic and large computation power to calculate the ideal transportation schedule that achieves stated objectives. Several technology solutions available in the market allow schedulers to 'schedule' volumes, but what they really allow is for a human to 'tell' the machine what the schedule should be and not for the machine to tell the scheduler

what an 'ideal' schedule looks like. We are yet to see this problem solved in any form or shape across existing products.

Collectively, the solutions can result in improvement to capacity utilization in the range of 0-5% or sometimes more. It directly impacts the top line of pipeline companies.

Reduce cost of operations

The diagram below illustrates the broad cost areas for a pipeline operator:



- 1) The cost of power is a big component of overall pipeline operational costs (accounting for 20-25% of overall pipeline operational costs). It can be brought down by optimizing the flow rates in the pipeline, identification of the ideal commodity mix, use of drag reducing agents, minimizing shutdowns. Identifying natural flow rates is a good first step (the flow rate at which a combination of motor(s) operates at the best efficiency). Based on pipeline design, the motors, the frictional coefficients, the slope, the type of commodity, it is possible to construct models that identify the optimum flow rates for pumping a certain amount of volume. Once it is identified, commodities can be moved in the pipeline by appropriate routing and scheduling. It is possible to reduce costs of power in the range of 2-5% based on optimal scheduling.
- 2) There is also scope for significant cost savings in salaries and wages through automation in the entire O2C cycle. This is possible through automation in these areas:

- a. Routing of volumes through the appropriate logical routes
- b. Planning and scheduling of volumes
- c. Invoicing
- d. Audits (three-way matches)
- e. Event detection
- f. Ticket management

Improve customer satisfaction

Shippers require flexibility in transportation (to be able to transport from a variety of sources to destinations), world-class service in terms of minimal degradation of crude, predictable deliveries and accelerated time to deliver. These objectives can be met by

- 1) Providing visibility on transit time of batches and estimated expected arrival times
- 2) Improving accuracy in ticketing and invoicing
- 3) Reducing degradation of product by appropriate buffering, commodity trains, ensuring similar commodities are grouped together while transporting
- 4) Avoiding delays in delivery
- 5) Facilitating easy trading and swapping of their commodity within the network
- 6) Providing delivery of product order and size
- 7) Allowing smooth ownership transfer once the product is traded to a counterparty
- 8) Notifications or alerts when a shipper's batch has crossed certain locations
- 9) Real-time and updated view of published pipeline schedule
- 10) Updates on any slowdown or leakage in pipelines
- 11) Facilitate quality and quantity inspection at delivery locations

Human capital management

The pipeline industry employs experienced schedulers and it is imperative for pipeline companies to develop systems and processes in such a way that their knowledge is captured and leveraged throughout the life of the pipeline. Any systems developed by pipeline operators should facilitate these areas:

- 1) Reduce dependence on knowledge or experience of a small number of schedulers and operators
- 2) Make training easier to onboard new schedulers and operators
- 3) Reduce attrition of skilled labor
- 4) Job enablement and enrichment

Enable decision making

Pipeline companies still use archaic data capture tools to manage their complex operational systems. Operators need analytical capabilities which can empower them to focus on key challenges and perform long-term capacity planning as well as facilitate better decision-making abilities to manage their day-to-day operations. Current and new systems need to be augmented with these capabilities to equip operators:

- 1) Provide intelligence and analytics to enable better decision making
- 2) Ability to undertake long-term planning and what-if analysis
- 3) Prioritize oil transport over IT issues
- 4) Address data inaccuracy, insufficiency, unavailability, delayed availability, inapplicability issues

Solution

Our point of view explains the approach to create an 'iO2C2 – an intelligent cloud processing hub' which solves these problems.

The vision for iO2C2

iO2C2 will be a cloud-based connected platform, to enable smarter transportation of oil and gas products through linked pipeline and terminal facilities. This platform brings together all pipeline operators into a single order-to-cash system on the cloud such that the entire transportation industry runs and manages their end-to-end order-to-cash process in this system.

Pipeline order-to-cash solution

In the current scenario, each pipeline operator invests in developing the ecosystem to support their order-to-cash operations. The features of solutions vary from operator to operator based on the complexity of their network.

Our proposed solution has pre-defined modules which will cover operational nuances of a pipeline from nominations to invoicing, as well as generic system capabilities such as network setup and analytics.



Our solution offers scalability and agility to pipeline operators. Rather than focusing on managing old, archaic, and disparate systems, they can configure their network setup on this solution and the system will automate their entire order-to-cash operations.

It will enable pipeline operators to become more competitive as they gain access to this platform at a lower price compared to investing capex to build it themselves. They can focus on their main area of operations of physically shipping commodities, and let the platform provider be responsible for managing tools and systems.

Key components of O2C2 solution

Network setup

This module is meant to be the main building block for the entire solution. It will allow pipeline operators to configure their entire network, its capacity, and operational rules. For example:

- Equipment configuration – set up pipelines, segments, linked operational tanks, terminals, storage tanks
- Capacity data – capture design and operating capacity for a pipeline by simulating different densities of commodities
- Rules – configure all operational and scheduling rules such as buffer, commodity to line assignment, commodity cycle rule

This module is imperative to allow pipeline companies manage growth and scale. Many pipeline systems do not support organic or inorganic growth in a smooth manner. They require some sort of technology upgrade to support such changes. However, given the frequent nature of capacity additions and modifications and inorganic acquisitions in the pipeline sector, it becomes very important for solutions to be able to scale to different network configurations easily without depending on a technology upgrade every time it happens.

Customer portal

The customer portals of many companies are limited in their customer focus – and function as a nomination submission system. We propose creating a customer facing portal available on the Web and mobile which will provide several additional suites of services to shippers of pipeline operators to make them more efficient, by enabling them to:

- Manage multiple contracts and track their renewal
- Submit nominations, view allocated capacity, and submit change requests

- Analyze historical nominations and allocated capacity
- View published schedule
- Track movement of batches and final delivered volumes
- View final invoices, raise billing queries, if any
- View upcoming maintenance and its impact on available capacity

Routing

In many companies, routing and allocation are done manually. Technology is used only to support storage of the manually calculated values. In the new O2C2 solution, we propose adding the following functionalities:

- Determines available capacity based on density of commodities nominated for a month, unshipped volumes from previous month, reduction in capacity due to high priority maintenance activities and any other user defined capacity constraints
- Volumetrically allocates to nominated volumes to available capacity and determine apportionment, if any
- While allocating volumes, it determines the optimal route based on available logical route between source and destination that the commodity needs to travel, honoring allocation and scheduling rules
- In addition, it also has an optimization engine which will move volumes between alternative available route based on wider objective function defined for allocation to reduce power cost, quality cost, or transit time
- Finally, it prepares a schedule which details batches, its size (volume), which pipeline and site it needs to be injected, at what rate the pipeline needs to be operated and which site batch needs to be taken out

Build plan / schedule

Today's systems do not 'plan' intelligently but are rather a place to store a manually evaluated plan which may be sub-optimal. This module allows operators to make smart plans by evaluating various optimization criteria such as reduced cost of operation, increased throughput:

- Monthly planning – operators can simulate multiple scenarios while allocating volumes based on business direction for that month e.g. allocate in such a way that power cost for the month is lowest, transit time of the accepted nominations is lowest, or asset utilization is highest
- Yearly planning – operators can do their yearly planning by virtually adding new pipelines, parallel pipelines on existing routes, increasing capacity of pipelines, adding more tanks at current terminals, changing the commodity mix which can be shipped and stored, changing operating models for a pipeline and mechanism of calculating apportionment (equally, equitably, based on distance). It allows the user to simulate the impact of these changes on its revenue, operational costs (power cost, quality cost) and margins

Execute and manage schedule

Daily monitoring and management of schedules is extremely manually intensive. In this module, we propose a visual aid for pipeline operators. It allows operators to view the published schedule from an operator's lens. They can filter it based on

pipeline or a route or view by time (hour, day, week) or by feeder pipeline. These are different views of the same information, allowing operators to effectively execute the schedule and operate the pipeline.

During a typical month, operators receive ad hoc change requests from shippers to change delivery location, volume, type of commodity to be shipped. This module allows operators to effectively evaluate the impact of these change requests on the pipeline network before accepting or rejecting it.

Invoicing and accounting

This module allows operators to track the batches delivered at each destination. During the entire journey, unique batch IDs are generated and assigned to a parcel of commodity. The final volume delivered against each batch is reconciled against the volume transported by the shipper. Invoices are generated based on actual tariffs, volume delivered, specifications of the commodity.

This module also allows shippers to account for any other services provided to shippers such as mixing, heating, blending, and invoice them for these services.

Business analytics

This module has several inbuilt dashboards to aid decision making while operating the entire pipeline network. The dashboards support yearly planning, monthly planning while accepting nominations, analyzing historical nominations, deferring maintenance activities to increase available capacity, and analyze other key aspects.



Pipeline marketplace for capacity services

A module of the O2C2 solution, the marketplace for capacity services brings all pipeline operators and shippers on a single connected platform. It will be a global platform to ship commodities across the world. As operators subscribe to the platform, the network of connected facilities between multiple sources and destinations to different transport commodities will grow. The three key stakeholders of this platform will be shippers, pipeline operators, and platform service providers.

Shippers have a universal experience to search for available routes and alternatives, available capacity on different routes, different service providers, tariffs, and ratings given by other shippers to operators on adherence to transit time, product quality and customer service.

Operators have a unique opportunity to connect with fellow pipeline operators and share information about their schedule, pipeline downtime, available spot capacity, and trade swaps.

A platform service provider will build and operate a robust platform to support business operations of shippers and pipeline operators. The platform will be designed to scale and will operate under different business models such as transaction based, monthly usage, and other mechanisms. It will adhere to industry rules and regulations decided by the regulator.

Benefits of a pipeline market place for capacity services

Given the current situation where operators and shippers are under margin pressure, this platform which benefit everyone.

Benefits to a shipper

- Single nomination portal – Shippers will be able to submit their nominations on a single platform rather than submitting multiple nominations on different customer portals. This gives them a uniform customer experience

- Alternative service providers – Shippers will be able to choose their preferred pipeline operator if multiple operators operate between a source and destination
- Spot capacity – Operators will be able to market their available spot capacity to other shippers
- Available services – Shippers will be well informed about the available services at different storages such as heating, mixing
- Opportunities to trade better – Both shippers and operators will be able to share information about capacity, available commodities and services, facilitating better trading opportunities
- Better visibility on transit time

Benefits to a pipeline operator

- This solution offers pipeline operators the ability to expand organically as well as inorganically without investing significantly in IT
- They become more self-sufficient and business-driven rather than depending on technology initiatives
- IT infrastructure cost reduction – a PaaS solution will significantly reduce annual expenditure on IT
- Standardized data and information exchange becomes possible, improving business efficiency
- Avoids significant capex to build order-to-cash solutions and can use simple service fee- based models

Benefits to the industry and regulators

- Reduction in carbon emissions – By providing information about available commodities in different markets, it will encourage operators to swap those commodities, abandoning transportation, which will contribute to a reduction in carbon emissions

- Improved data standards and information availability to stakeholders leading to better decision making across the industry
- Allows better demand supply management
- Improved and easier regulatory reporting as information emanates from one source

Enhance your competitive advantage

Although the solution is on the cloud, price discovery, capacity management strategies, routing and scheduling algorithms, and optimization nuances belong to specific operators themselves and will not be shared between operators. If a pipeline operator subscribes to this service, to the enterprise becomes more agile in responding to market dynamics.

Why O2C2?

Our solution essentially modernizes and transforms the way pipeline companies operated for several years. In low-margin scenarios, these technology solutions are essential to save costs and improve revenues.

The dependence on specific teams to manually perform tasks such as capturing operational knowledge or managing network changes will be automated. It will create less dependence on IT and allow more self-reliance for business users.

Shippers (who are customers) will have a superior user experience at customer-facing portals. The portals will be more engaging and work on a self-service and cost-effective model.

Our solution will also help improve overall network reliability and maintain pipeline integrity. It will help schedulers evaluate multiple scenarios for allocation and scheduling, enabling them to take decisions based on evidence rather than experience. This will eventually have a impact on the top line of these companies. Employees will need agile ways of working to use intuitive technology.

Conclusion

As Steve Jobs said, 'Innovation distinguishes between a leader and a follower'. Pipeline operators are slow in adopting new technologies to automate their operational inefficiencies. We believe that pipeline companies need to ask fundamental questions:

- What measures to adopt for organic and inorganic growth?
- What competitive advantage provides efficient services to customers while bringing down the cost of operations?
- What checks and balances in order-to-cash processes maintain pipeline operations integrity?
- How to remain agile and better respond to changing market conditions?

We believe that adopting such solutions will help pipeline companies achieve their goals faster and in a more efficient manner. A consortium of pipeline operators need to come together and make this vision a reality.

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References

- 1 https://portal.phmsa.dot.gov/analytics/saw.dll?Portalpages&PortalPath=%2Fshared%2FPDM%20Public%20Website%2F_portal%2FPublic%20Reports&Page=Infrastructure
- 2 <https://pgjonline.com/magazine/2019/january-2019-vol-246-no-1/features/2019-global-pipeline-construction-outlook>
- 3 https://www.eia.gov/dnav/pet/pet_move_pipe_a_EP00_LMV_mbb1_m.htm
- 4 <https://www.cer-rec.gc.ca/bts/whwr/rspnsblt/trffctltrff-eng.html>
- 5 <https://www.bloomberg.com/news/articles/2020-07-22/oil-sands-slow-return-keeps-canadian-pipelines-partly-empty>
- 6 <https://www.capp.ca/publications-and-statistics/crude-oil-forecast>
- 7 https://en.wikipedia.org/wiki/Drag_reducing_agent
- 8 Infosys experience from executing projects of similar nature
- 9 Statistics Canada: Pipeline Transportation of Crude Oil and Refined Petroleum Products 2000
- 10 <http://publications.gc.ca/collections/Collection-R/Statcan/55-201-XIB/0000055-201-XIB.pdf>

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