CHEMICAL MANAGEMENT PROGRAM FROM THE POINT OF VIEW OF THE OPERATOR AND THE CHEMICAL VENDOR

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ABSTRACT
A chemical management program is an integral part of reducing downhole and surface failures. The success of a chemical management program is dependent on the operator and the chemical vendor understanding the expectations and responsibilities assigned to each party. This paper identifies some critical tasks associated with a successful program to help clarify the responsible parties for each task. The terms of the business contract are then defined around these tasks.

INTRODUCTION
The typical definition of a chemical management program (CMP) is to ensure application of the appropriate chemical, at the right place, in the precise amount, and at the correct time. If this view is adopted, then expectations are developed around the application of chemicals, but not the reasoning behind using chemicals in the first place. With these assumptions, the role of chemicals in the oilfield does not address *why* the chemicals are being used, which is to prevent corrosion, prevent the formation of scale, reduce the impact of bacteria, and to break emulsions to ultimately reduce operating expenses and downtime.

An alternate definition of a CMP is a process to manage the application of chemicals to reduce failures and associated repair costs, reduce unscheduled downtime and ensure marketability of produced products. By using this definition, the expectations of the chemical vendor are instead value-driven and align with the expectations of the operator to support the overall goal to reduce equipment failures.

The business agreement between the operator and chemical vendor (and other related parties such as pump shops and artificial lift suppliers) should include aligned expectations, defined responsibilities, clear key performance indicators (KPIs), and define an organizational structure to execute the agreement terms. Including these items will help to ensure the business arrangement will work to benefit all parties.

EXPECTATIONS
To be successful, the goals of a CMP must go beyond selecting the proper chemical, ensuring it is applied effectively, and using the correct dosage at the right time. Accordingly, the expectations should go beyond sampling frequency, making sure the chemical tanks are full, failure samples are collected and attending failure meetings. Though these tasks are important, they miss the reason behind using chemicals in the first place.

Chemical application is a critical—but not exclusive—role in the overall effort to reduce equipment failures, downtime, and associated expenses. Not all failures can be prevented with the use of chemical. For example, the chemical vendor cannot be held accountable for a failure caused by an installation malfunction, manufacturing defect or design error. Conversely, if a failure mode is determined to be corrosion related, the chemical application, including chemical choice, dosage, and application method, must be investigated to determine if it is effective or not.

Expectations of a successful CMP should be value-driven and include expectations to:

1) Improve reliability. Downhole and surface failures and unscheduled downtime that could have been prevented with proper use of chemicals must continually be reduced.
2) Meet quality requirements. The marketability of the produced products (oil, water, and gas) meets the customer's specifications.
3) Meet regulatory requirements. Environmental events that could have been prevented with proper chemical application are reduced and regulatory reporting obligations are met.
4) Be cost effective. The savings from a chemical treating program must be far greater than the cost of such program.

These expectations cannot be placed on just one party of the business relationship. The operator needs the technical expertise from the chemical vendor to determine if/when chemicals should be applied, the method of application and the dosage, among other things. The chemical vendor needs to know the downhole configuration of each well, the well's production rate, and when wells are put online. Most importantly, everyone involved in reducing equipment failures need to know who is supposed to do what, when, why, and how chemicals are being used.

KEY PERFORMANCE INDICATORS

KPIs should be developed around these expectations. KPIs are loosely defined as the measure of the financial and operational success of the business agreement. Such metrics should be relevant to the business, made known to the organization, kept up-to-date and used in assessing if the performance meets expectations.

1) Financial metrics:
   a) Total chemical spend by month
   b) Normalized chemical spend by month ($/BO, $/MCF, $/BW)
   c) Normalized chemical spend by type (corrosion, scale, biocide, etc.)
   d) Normalized chemical spend by application (continuous, batch, other)
2) Performance metrics (for chemically-preventable failures only):
   a) Failure rate/well/year and mean time to failure (MTTF) by failures by type (corrosion, scale, bacteria, etc.)
   b) Failure rate and MTTF by failed component
   c) Number of downhole failures and total workover costs by month
   d) Review of every failure with findings, cause, and recommendations
   e) Infant failure rate
3) Application metrics:
   a) Chemical treatment rate vs. target (histogram)
   b) Residual rate versus target (histogram)
4) List of changes to the chemical program since last report (new installations, treatment rate changes, chemical application changes, specialty treatments)
5) Service quality indicators (new service start up time, reliability of chemical treatment equipment)

ORGANIZATIONAL SUPPORT

To execute the business agreement between the operator and chemical vendor, consideration should be made to create and support an organizational structure charged with meeting the terms and expectations defined in the agreement. One concept used is creating a Leadership Chemical Management Team (LCMT) at the Business Unit level to ensure the agreement is meeting the defined expectations and both parties are benefiting. This team should consist of:

1) Chemical Vendor Account Manager
2) BU Chemical Oversight Leader
3) BU Purchasing Account Manager
4) BU Operations Manager

LCMT critical tasks:
1) Defining ownership of equipment used to apply the chemicals
2) Assigning responsibility for maintenance of the equipment used to apply the chemicals
3) Reviewing the financial KPIs as defined in the business agreement
4) Supporting the Asset Level Chemical Management Team (ACMT) with necessary personnel to succeed

The ACMT should consist of:
1) Local Chemical Representative
2) Subject Matter Experts (corrosion, scale, biological, metallurgy, etc.)
3) Local Chemical Team Leader
4) Production Engineer
5) Facility Engineer
6) Production Supervisor
7) Artificial Lift Techs/Optimizers
8) Artificial Lift Service Provider

ACMT critical tasks:
1) Communicating production rates and new well startups
2) Defining metrics for determining which wells/equipment need chemical treatment
3) When needed, determine the chemical choice, application method and treatment rate
4) Proactively managing the chemical inventory at each storage location
5) Monitoring effectiveness of the chemical treatment
6) For each failure, collect appropriate samples of the failed parts, operating practices, and environment to determine the root cause of the failure and recommended actions
7) Report defined KPIs as dictated by the business agreement

A tool used to define and communicate such responsibilities is a Responsibility Assignment Matrix or RACI matrix. This tool is a method to describe the level of participation in tasks in a multifunctional process. RACI is an acronym for Responsible, Accountable, Consulted, and Informed, with each having defined level of responsibilities. A completed RACI matrix helps to define who is supposed to do what as shown in **Figure 1**.

MULTIPLE PARTY BUSINESS "IDEAL" AGREEMENT FORMATS

Background

The concept of an agreement between multiple parties is to strike a balance where each party benefits through the value generated. The agreement between a chemical vendor and an oil and gas operator are no different. For decades, a typical agreement has existed where an operator would not utilize chemicals in producing wells until there was a need, such as a failure. A bidding process would begin, and the invited chemical vendors would present their best package based on the operator's requirements. Because many chemicals have become commoditized, many chemical vendors were forced to compete through the infamous 'price-per-gallon' business model. In short, this model would be presented to the operator as a single price they would pay for the amount of chemical injected, as well as any service work tied to the assets that utilize the chemical. Operators typically did not see line item charges for field service trips for fluid testing, chemical tank levels, and chemical pump rate monitoring.

At first glance, the operator appears to have the upper hand in this type of agreement, but there is more to this than what is typically discussed and usually surfaces within months after a signed agreement. If the service costs are rolled into the cost per gallon of chemical, it stands to reason that the assets utilizing the most chemical would require most of the chemical vendor's time. Higher utilization of the chemical allows chemical vendors to spend more time and effort on these assets to make sure everything is working as expected and more fluid testing is done. On the other hand, the wells with little-to-no chemical use are often neglected. No chemical utilization means there is no profit margin cushion for the chemical vendors to send out field service technicians. Neglected wells often lead to multiple failures, increasing costs for the operator.

From the explanation above, there are two main problems with the current process, one for the operator and one for the chemical vendor. The operator holds out on using chemicals until they see a need, limiting the chemical vendor to a reactive chemical solution and placing no incentive on being proactive. In contrast, the chemical vendor's business model is structured to have minimal resources offered to the operator, limiting the opportunity to expand service to more assets, and restricting value generation.

Operator – Chemical Vendor Agreements

Ideally, an agreement between an operator and chemical vendor is established as early as possible. Operators spend years planning the development of a field to fully understand what type of environment they are drilling into and the quality of the production during the early years. Many reservoirs have some type of chemical issue that a chemical vendor would be able to assist with and help overall recovery from these assets. The bidding process begins before production of these assets for chemical vendors to be proactive in their treatment programs. Chemical vendors need to change their current business models to increase revenue and also provide long-term value for the operator.

Operators can benefit from bringing in chemical vendors as early as possible in many ways. As the first fluids are produced from the assets, samples can be analyzed to determine the likelihood of chemical deposition. Formulations are evaluated and chosen early in the production process and rolled out to all assets. The operator begins to establish a relationship with the chemical vendor to determine a baseline of chemical composition of the fluids. As the fluid composition changes over time, new samples are analyzed, and new chemicals are evaluated and chosen for the next phase of life for the producing assets. This leads to a higher recovery factor and less failures for the assets, proving the value the chemical vendor provides to the operator.

Chemical vendors can improve agreements with operators by changing outdated “price-per-gallon” business models. An issue in the current business model is the operator does not see all the services that tie into chemical. This dilutes the value the chemical vendor provides because if the operator does not see everything the chemical vendor does to make the chemical program work for the assets, the operator tends to push out the chemical vendor and becomes its own servicers of the chemical program. Only when specialty chemicals are utilized would the operator defer to the expertise of the chemical vendor. By splitting out the price of the chemical and the price of services in the initial agreement, it’s easier for the operator to understand the components required to implement and sustain a successful chemical program, aiding in bid comparisons from other chemical vendors. This conveys the value provided by the chemical vendors and fosters a mutually beneficial relationship that outlasts commodity-based agreements of the past. Lastly, if value and relationships are established, it may change the current reflex of cutting chemical programs during downturns in the industry or using chemical programs as support instead of determining the root cause of an existing problem.

Operator – Chemical Vendor – Artificial Lift Service Provider Agreements

At this stage, operator and chemical vendor relationships are established and how each side can improve their agreements with one another has been addressed. Now an additional agreement must be introduced with another party, the artificial lift service (ALS) provider. (A more in-depth review on artificial lift equipment and run life will be addressed later in the paper, but this section will serve as a way ALS providers can aid in the agreement process of the operator and the chemical vendor.)

The leaders in the chemical vendor space can take the next step providing exceptional service to operators by digitizing their efforts and this is where the ALS providers can be of enormous help. ALS providers have taken advantage of some form of digitization for decades to provide operators value and a high return on their artificial lift equipment investments. Most ALS providers offer a remote monitoring service or SCADA system to monitor and control the equipment in the field. Power feeds these assets by line or generator, and a controller or RTU collecting information from the equipment sends back to the remote monitoring centers. Chemical vendors utilize this existing equipment and supply supplementary chemical tanks, pumps, and controllers – which can be tied into the existing communication infrastructure and sent to the same remote monitoring centers as well as to the chemical vendors.

By digitizing the chemical program, the operator will see more value because there is meaningful data recorded at each asset. Operators can then combine chemical data with existing artificial lift data, creating new insights and taking action within a much shorter decision cycle than today. The chemical vendors can then see how much chemical is being used and whether the injection pumps are working, without sending someone to the asset. This may decrease costs to the chemical vendors, in turn cutting costs passed to the operator. The chemical vendors can also forecast the amount of chemical needed to have in inventory and accurately plan when tanks need to be refilled, reducing truck hauling costs and HSE concerns.

Adding this technology has benefits for both the operator and chemical vendors, but likely the most impactful factor is the growth of value the operator sees, which reverses the commoditization of the chemical vendors.

CHEMICAL SELECTION/APPLICATION METHOD

Choosing the correct chemical and application is a critical component to mitigating failures within a production system. To properly understand potential chemical candidates, a deep understanding of relevant failure mechanism likelihoods is needed first. These internal failure mechanisms typically fall within broader buckets (asset integrity, flow assurance, and phase separation) and can expand and contract in scope depending on the system. Examples of asset integrity failure mechanisms include acid gas corrosion, microbial induced corrosion, and oxygen corrosion. Each of these has different modes of attack and different approaches to mitigation.

There are numerous tools that leverage data to understand the likelihood of these occurring, which include, but are not limited to:

- Quantitative Means
    - Commercially-available models (corrosion, scale, etc.)
    - Joint industry project (JIP) derived models (corrosion, scale, etc.)
    - In-house developed modelling software (corrosion, scale, etc.)
    - Correlation models
- Qualitative Means
    - Industry guidelines (AMPP, API, ASME, SPE, etc.)
    - Material selection guidelines (AMPP, API, ASME, SPE, etc.)
    - Consultancy

Guides on minimum data requirements and the interpretation of outputs are provided through the same paths but can often be subjective. Quality of method also differs greatly from one model or guideline to the next and is subject to debate. Some of this discussion has been had within a public forum with published white papers available that compare varying model base assumptions and output accuracy. An example of some qualitative guidelines is provided **Figure 2**.

Once awareness of failure mechanism likelihoods is established, focus is placed on determining the chemical and application. Application method is often dictated by physical system constraints and operational preferences, but also dependent on the chemistry selected. This decision can be a very intensive process varying on the system's operational windows and the relevant chemistries involved, but best practice approaches generally adhere to the following framework:

- Primary chemical qualification
  - Applicable benchtop/lab performance test
- Secondary chemical qualification
  - Fluid compatibility check
    - Emulsion tendency evaluation
    - Water quality evaluation
    - Foaming evaluation
  - Material compatibility check (for areas with neat chemical contact)
    - Metallics
    - Non-metallics (elastomers)
  - Product to product compatibility check (when multiple chemical applications are involved)
- Application considerations
  - Is the location of injection site adequate for necessary contact time/mixing?
  - Does the injection point utilize quills or other applicable equipment (ex. pulsation dampeners)?
  - Is the chemical pump designed to meet desired delivery consistency?
  - Is the chemical being injected as intended?
    - Is a makedown unit required?
    - Is a dilution or flush required?
  - Operationally, is circulation necessary to achieve the desired result?

Following these guidelines leads to a solid foundation for chemical treatment in helping achieve improved integrity, restriction-free flow, and proper fluid separation throughout production life. Using best practice approaches like this ensure the chemical used is technically justified, fit for purpose, and effective.

EQUIPMENT OPERATION, MAINTENANCE AND REPAIRS

Proper upkeep of chemical injection equipment is vital to an effective chemical program. This service can normally go one of two routes; operator-owned/operated or chemical vendor-owned/operated. Each option carries its own advantages as shown in **Figure 3**.

The option pursued is often tied to the facility of interest. When looking at more permanent installations such as a tank battery, gas plant, or offshore platform, operator-owned/operated equipment is much more prevalent. On individual well pads or more temporary facilities, chemical vendor-owned/operated setups are more common.

In either instance, proper communication between the operator and chemical vendor is vital to achieving ideal uptime and desired rates. The chemical vendor should be in constant communication with the operator as it relates to the effectiveness of the chemical and what adjustments or optimizations need to be made to ensure the application achieves its mitigation intent. This is often managed through a service agreement, which lays out in plain terms the key metrics to track and the associated key performance indicators (KPIs)/key stress indicators (KSIs). KPIs are generally a measure of adherence to the service agreement, while KSIs are evaluations of measurement results vs. an established threshold. Specifically for monitoring equipment uptime and desired injection adherence, it is best to track two separate metrics:

- Injection compliance
  - Comparison of actual volume vs. target volume
    - For example, +/- 10% is a common threshold
- Injection availability
  - Calculation of percent time spent at target rate
    - For example, +/- 5% is a common threshold

Injection availability can be an especially difficult metric to understand in remote areas with no automation in place. For these areas, rates are checked infrequently, which limits the ability to understand whether a chemical pump has been able to maintain consistent injection alongside the associated production flow. Regardless, limited information is still useful in driving improvement to the process.

Both operator and chemical vendors benefit from this cooperative approach, as ownership and oversight reside jointly to help drive better outcomes.

INVENTORY MANAGEMENT

Frequent tracking of chemical volumes on hand for a given application is an important criterion of a chemical program. This information is useful for several steps within the inventory management process, including:

- Improved visibility into forecasting/re-ordering
- Consumption calibration for other measurement means
- Optimized deliveries (and associated costs)

In this line of thinking, a best practice approach to leverage chemical level surveillance data is to put it in context with current consumption rates. Comparing the volume of chemical available to use versus the daily draw down, calculates a “days on hand” value. This metric, which is often a KSI for areas with more constrained infrastructure (offshore), is useful information in optimizing supply chain operations and ensuring supply assurance. Usefulness is often tied to frequency of data collection, but inputs on even a monthly basis can shed new insights.

DATA REQUIREMENTS, DATA MANAGEMENT AND AUTOMATION

Data collection required to create defined KPIs and reporting obligations

Two of the main sources of data collection are the artificial lift systems from the operator and the chemical analysis from the chemical vendor. For operators, much of this information is recorded in digital format, allowing for immediate aggregation of multiple systems of data into one database. Many SCADA systems record information about the equipment and downhole operating conditions on a continuous basis, while installations and service records are stored in other software applications. The chemical vendor usually maintains their own databases that store all of their customers’ chemical program data with some having the ability to grant their customers access to their data through a portal or offer scheduled reporting. By working together with the vast amount of data available, both parties can define KPIs to measure the success of a chemical program or iterate on a process until successful.

Database definition and content

To discuss in more detail the information recorded and maintained by the chemical vendors, a sample database structure is shared. Each entry below provides enough information to determine the best course of action to implement a chemical program for an operator and allows for optimization of the program over time.

- Temperature
- Pressure
- Well tests
- Oil and water analyses
- Bacteria testing
- Residual testing
- Treatment rate and volume
- Inventory
- Solids analyses
- Coupon results

Failure Meeting data requirements and preparation

Data requirements and preparation for chemical vendors require understanding what the operator plans to accomplish in the failure meeting. Usually, the operator will have a standing meeting in regular intervals with many of the same parties in attendance. The only point that changes is which well failures are to be analyzed during the meeting. The chemical vendors, artificial lift technicians, rig supervisors and other parties must know ahead of the meeting with sufficient time to gather all data collected for those wells and prepare a summary report for each well. This allows for a seamless meeting of investigation to determine a root cause of failure.

In addition to data, the same chemical vendor field service technician should attend all the meetings applicable to the area in order to build a relationship with everyone in attendance. This builds credibility for the chemical vendor and also creates a sense of shared responsibility and ownership for each failure.

Current efforts and moving into analytics

Currently, the information recorded by operators and chemical vendors are kept separate. Each database is used for other internal and external business programs. If data is shared between companies, it is on a case-by-case basis and upon request. The quality of data maintained by the chemical vendors is limited by how often analyses can be re-run to update chemical models. Data can be weeks to month's old leading to inaccurate modeling and less impactful chemical treating because surface and downhole conditions may have changed during that time frame.

A proposed new model links the data between the operator and the chemical vendors. One way to do this is to utilize a SCADA system most operators use today to record data from each well. It is likely that most of the data chemical vendors need (temperature, pressure, production) to run a model is provided from the information stored in the SCADA database. The remaining data required (oil and water samples) are collected by the chemical vendors at regular intervals. This sharing of SCADA data allows for continuous model updates, and the outputs can then be shared with the operator. Changes in chemicals, treatment strategy, and usage can be done in a much faster loop. This information then becomes a new section in the reporting by the chemical vendors used in failure meetings.

The next phase of the model would be to feed the model outcome back to the operator to start drawing comparisons between SCADA data and chemical model data. If suspected chemical deposition is occurring, the chemical models can help validate this and vice versa. This has the potential to change artificial lift operations in real time at the onset of suspected chemical deposition and take a prescriptive approach to chemical treatment if needed. This may prevent a failure of the artificial lift equipment, extending the run life and eliminating a costly workover.

The final phase of the model would be to automate the process and close the control loop. With the chemical deposition model data linked to the operator SCADA data, one piece of the puzzle is missing in order to close the control loop: the chemical injection equipment at the wellsite. The chemical tank level monitoring and pump injection rate and be hardwired into the exiting artificial lift automation equipment and integrated into the SCADA retrieval protocol. Now the operator has the artificial lift information, the chemical model outcome, and the ability to monitor tank levels and adjust dosage rates based on this information. To further enhance the process, this information can also be shared with the chemical vendors to manage services to only the wells that require chemical refills or equipment service. Both parties benefit from sharing this data, leading to insights previously out of reach due to unconnected resources.

ROOT CAUSE FAILURE ANALYSIS

Not all equipment failures can be prevented by the use of chemicals. Since the Chemical Management Program KPIs include only those failures which could have been prevented from the proper use of chemicals, there is a need for identifying the root cause.

The objective of root cause failure analysis (RCFA) is to identify the actionable cause of the failure to implement a change in either the design, installation or operational practice to reduce the likelihood of a similar failure occurring again. Chemical practices are typically considered within the operational phase of the well.

The design phase includes design practices, equipment selection, and material specification and expected operating parameters. The installation phase includes handling of materials during installation and any subsequent repair processes (sucker rod handling, tubing handling, sucker rod pump handling, etc.) The operation phase includes operating parameters (SPM, SL, VSD settings, POC fillage settings, etc.) and the chemical program (application of the right chemical at the right place in the right amount at the right time).

Failure meetings are typically the forum to conduct RCFA and to develop solutions to prevent similar failures. These meetings should be attended by enough people who have the knowledge about operations and failures, but not too many as to bog down the discussion. Suggested attendees, and their roles are:

- Operations Supervisor – Team leader, decision maker
- Artificial Lift / Engineering Tech – Meeting facilitator, record-keeper
- Production Engineer – Well history, design, equipment specs
- Rig Supervisor – Workover findings, samples and photos
- Well / Optimization Technician – Operating practices
- Pump Shop Representative – Pump teardown findings
- Chemical Vendor Representative – Failure recognition skills, chemical program

The Failure Meeting should have a dedicated facilitator, who also acts as record keeper, to keep the meeting on track and to enforce the meeting rules and follow the agenda.

- Start on time and with quick introductions. Avoid side-bar discussions.
- Review the agenda and the general KPI's
- ALL DATA MUST BE AVAILABLE
- The leader (or designee) will present the failure, including all pertinent information, data, and samples
- The leader will facilitate the RCFA discussion in order to determine the failure causes
- Record the failure description, mode, mechanisms, indicators, description and causes on the Well Failure Form
- Decide on a course of action/tasks to conduct the next time the well fails
- Review the updated results of active experiments
- Discuss any considerations of adding to or changing the Best Practices

If the root cause of a failure is determined to be attributed to a deficiency in the chemical program, that information would be included in the CMP metrics for further evaluation by the appropriate Chemical Management Team.

CONCLUSIONS

This paper focuses on key information, data, and expertise to build a sustainable and mutually beneficial relationship between the operator and chemical vendor. There are powerful tools in use today that are separated, and outcomes are only visible to one side of the business relationship. By creating a cohesive environment that combines the work of the operator and the chemical vendor, more value will be realized, artificial lift systems will have reduced failures, and chemical can be applied where it stands to make the largest impact for both parties. While this paper addresses KSI and KPI development, it does not address specialized business relationships where the business models differ based on performance of the chemical and the service work required to meet those performance metrics.

Tasks	Maintenance Supervisor	Maintenance Analyst	Maintenance Planner	Maintenance Technician	Maintenance Superintendent	Reliability Specialist	CMMS Project Engineer
Inputting Failure Data	A	C	I	R		C	C
Work Order Completion	R	C	C	C	A	I	I
Work Order Close Out	C	R	C		I	I	A
QA of Failure Data Input	C	R	I	C	I	C	A
Analyze Failure Reports	C	C	I	C	A	R	R
Maintenance Strategy Adjustments	C	I	I	C	A	R	R
Implementing New Strategies	R	I	R	C	A	I	I

Responsible "the doer"
Accountable "the buck stops here"
Consulted "in the loop"
Informed "kept in the picture"

Figure 1 - Example RACI Matrix

Risk level	Inorganic Scales		Acid Gases (mg/L)		Metals (mg/L)		Bacteria Bottles	Temp	Residuals	
	Carbonate	Sulfate	H2S	CO2	Fe	Mn			Corr	Scale
High	SDI >= 0.5	SSR >= 1	>= 50	>= 70	>= 50	>=2	>=3	>= 180	30-50 PPM	30 PPM
Moderate	0.4-0.49	0.9-0.99	May-49	60-69	30-49	1-1.9	2	130-179		
Low	<0.4	<0.9	<5	<60	<30	<1	<2	<130		
	*Stiff Davis Index	*Super Saturation Ratio			*High range with natural Fe					

Figure 2 - Qualitative Chemical Program KPIs

Operator-owned/operated advantages	Chemical Vendor-owned/operated advantages
Vendor-agnostic	Less workload for company
More control over equipment uptime (critical applications)	No need for company expertise
Easier DCS integration	Increased safety (vendor managed chemical exposure)
	Less equipment management (new/discontinued apps)

Figure 3 - Company vs. Chemical Vendor Owned Equipment