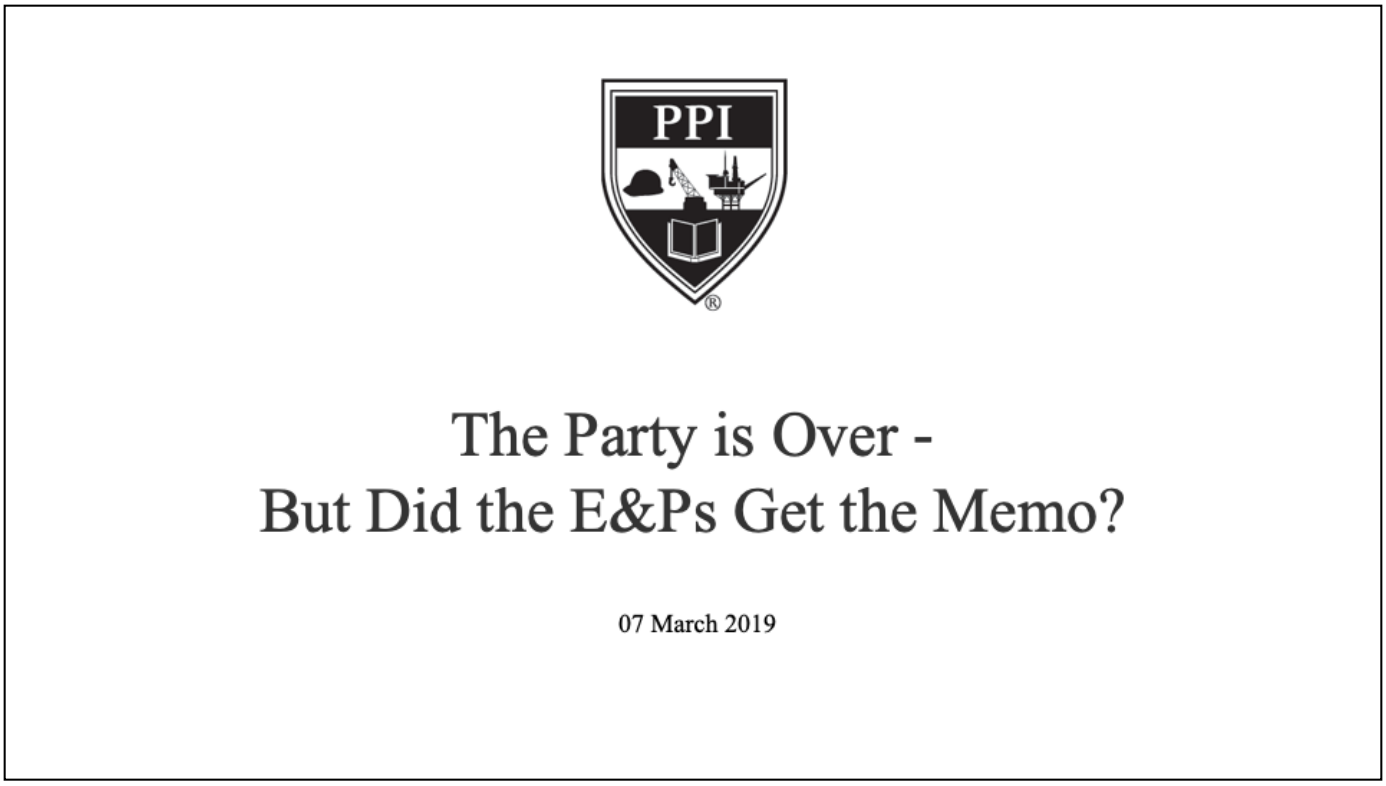
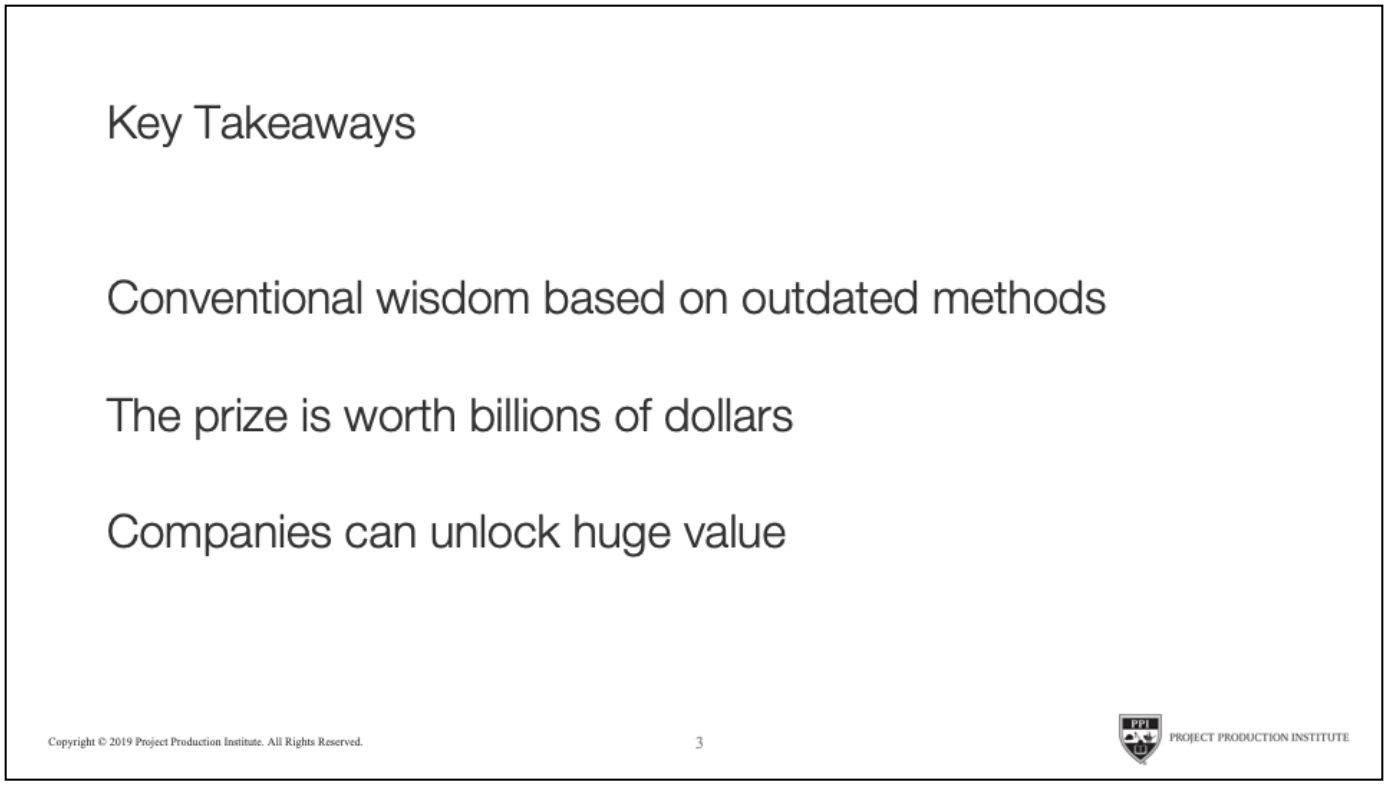


The following is a summary of a presentation co-hosted by PPI and Bernstein sell-side analyst Bob Brackett. The speakers are Amanda Goller, Director Analyst Communications for PPI, and Dr. H-J. James Choo, Member of the PPI Technical Committee and Chief Technical Officer of Strategic Project Solutions Inc.



The oil and gas industry has been a challenging investment space for the last few years. While there are many reasons for this, the outcome is that oil and gas is no longer competitive with other industries.

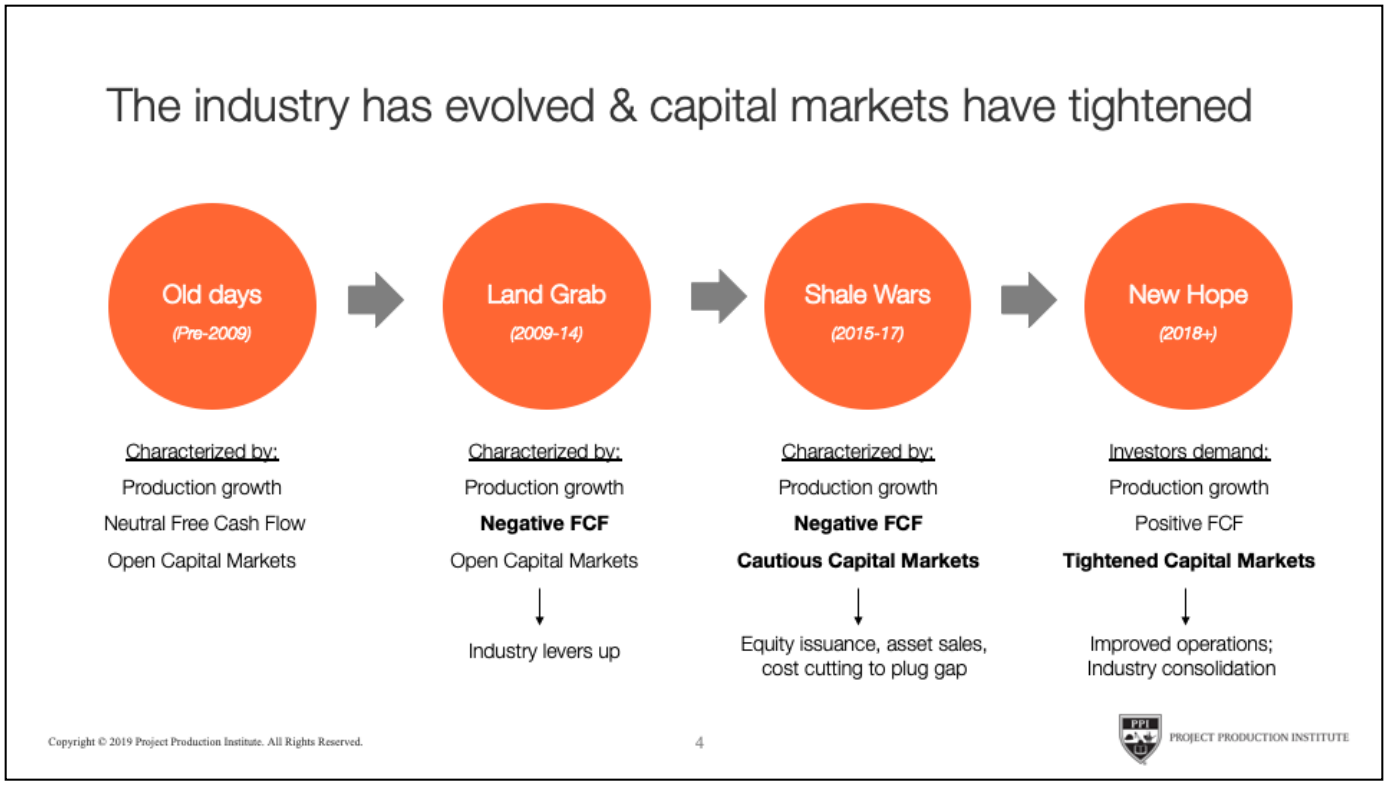
10 years ago, energy accounted for 13 percent of the S&P 500. Now, it accounts for just 6 percent. Therefore, the capital markets are looking elsewhere for investment returns and the days of easy money for E&Ps are over.

Is there anything else operators can do to improve capital efficiency? Yes, there is.

When it comes to capital investment and efficiency, the conventional wisdom in the industry is based on outdated methods of project management.

There is a gap in their current approach to project delivery. This gap results in operators unnecessarily tying up billions of dollars of cash that could be invested elsewhere or returned to shareholders.

Companies embracing production management have unlocked huge value. We're not talking about 5 to 10 percent gains. In most cases, we've seen 20% to 60% gains.



There have been a lot of changes in the oil and gas industry since 1999. Gasoline was only 80 cents a gallon, WTI was trading for less than $20 a barrel, and that's what we're calling here the "old days."

In the old days, pre-2009, unconventionals were a very small part of the global liquids picture, a bigger part for North American gas, smaller for global liquids. OPEC drove oil prices. US had net imports of 10 million barrels a day, and most non-OPEC growth was coming from international or offshore.

The industry was characterized by steady production growth. They were largely either free cash flow neutral or positive, and the capital markets would lend them money.

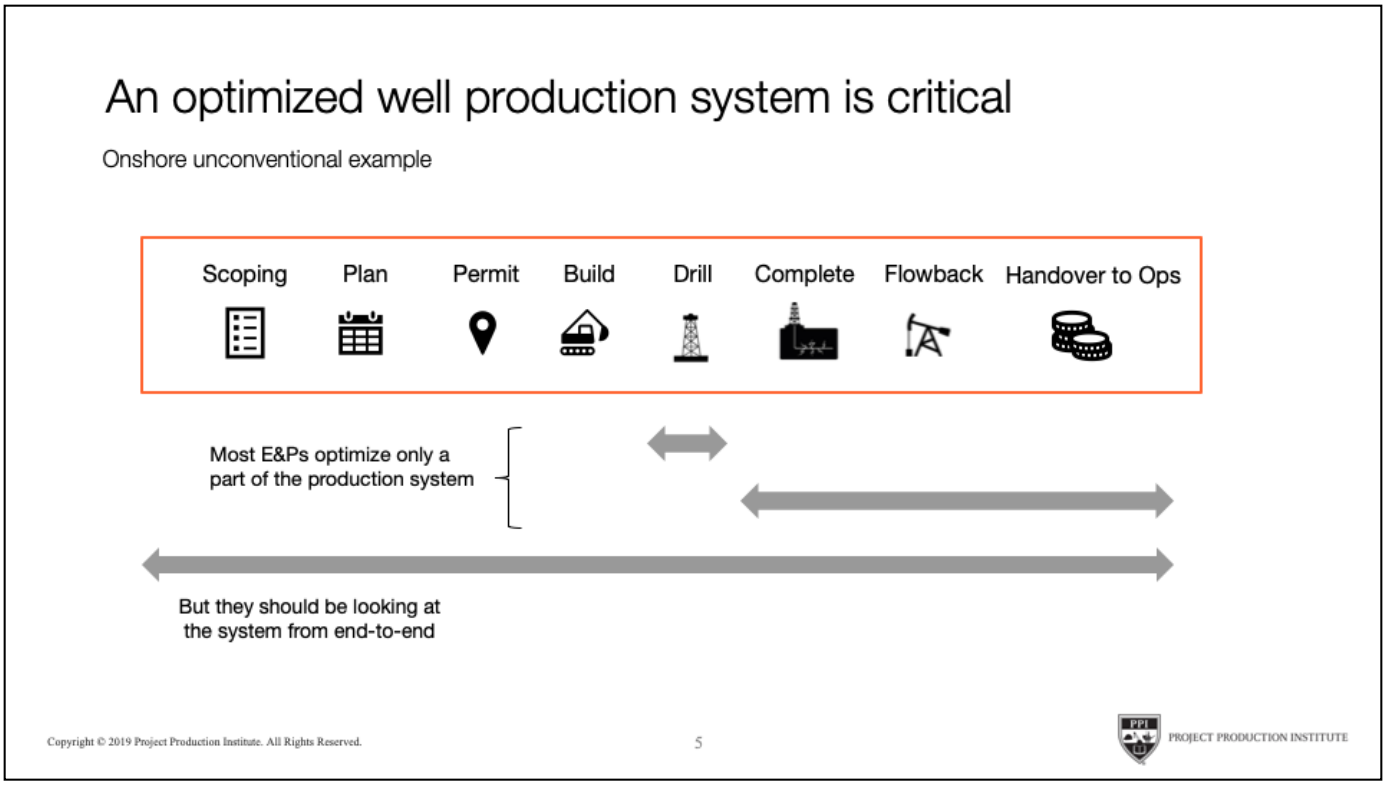
Going forward to '09 to '14, we had the land grab. This is characterized by production growth, negative free cash flow despite oil prices, and companies bought up a lot of land and other assets, because capital markets were still open, still willing to lend them money, and as a result, they levered up.

After the price crash late 2014, the industry tightened its belt a bit and we entered the shale wars. This is where the operators shifted their portfolios towards the most prolific shale plays. It was again characterized by production growth, free cash flow again very negative, but improving with management laying out clear goals to be free cash flow neutral.

However, the capital market started to get more cautious At the beginning of 2016, there was a three to six month window where companies could do equity issuances. After that closed up, to plug the free cash flow gap, operators had to resort to asset sales and other cost cutting initiatives.

Now, we're entering into what Bob Brackett has called the new hope. Investors are demanding production growth with positive free cash flow, and rightly so. Other industries have figured out how to improve their productivity. Manufacturing has improved three to four fold since the 1940s, while oil and gas has just bumbled along.

Therefore the capital markets have lost their patience. So, what happens next? We believe there is still room for substantial operational improvements and that the companies that embrace this way of thinking will be the ultimate new winners when the industry begins to consolidate down the road.



As we enter the so-called time of new hope (2018 and beyond) , we find that the majority of upstream capex is going to development, not acquisitions. As such, an optimized well production system is now critical.

Here, we're showing an example of a well factory. We prefer to call it a well production system. The graphic is highly simplified – a real system is going to have hundreds of tasks going on all at the same time, with around 1,000 tasks happening simultaneously at any given point of time.

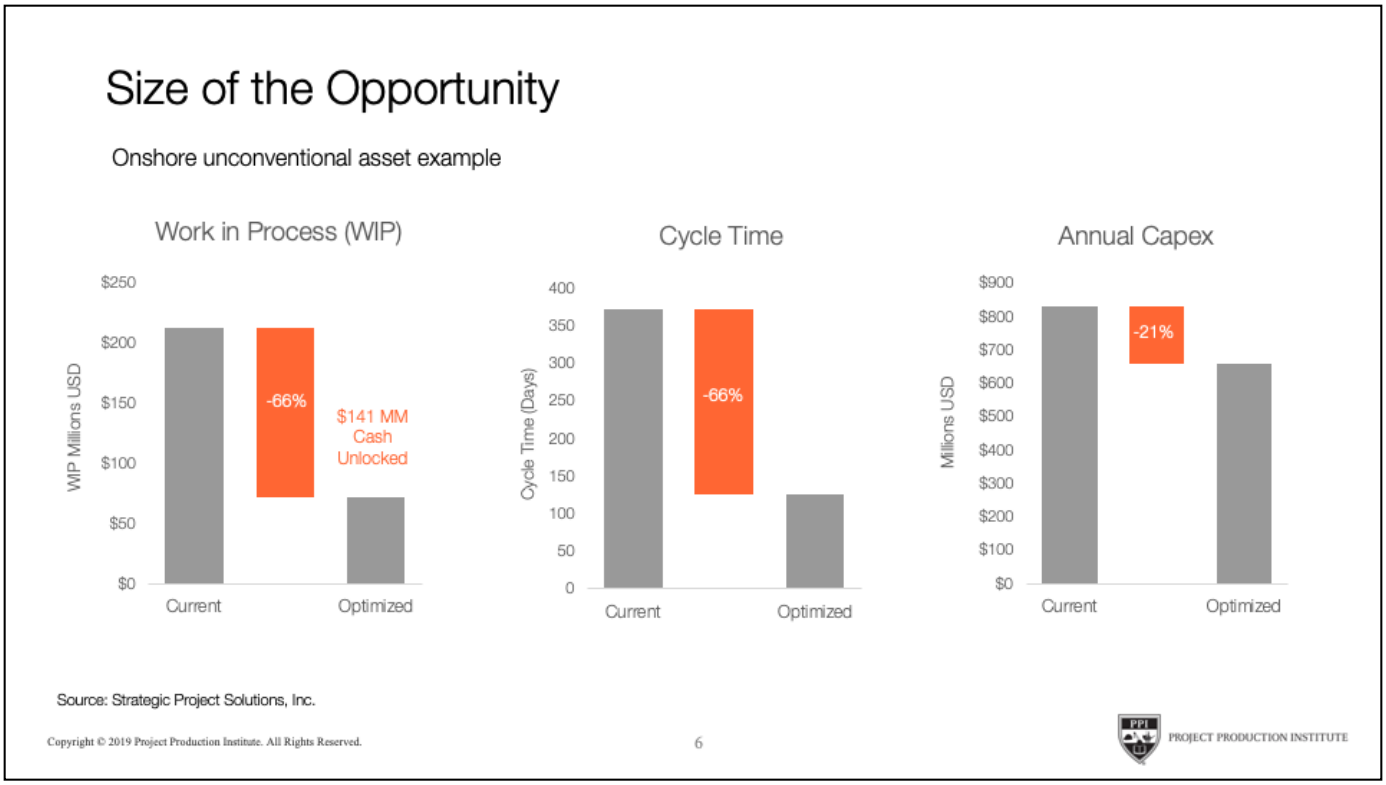
The system starts at well scoping and it ends at handover to operations when the well is put on production. This system itself is a capital project that produces wells.

Many E&Ps optimize certain activities in the system. For example, drill time, completion time or even fracturing start to first production. But when we look at their data, we see over and over again that while they've optimized one activity, the total time to produce the well stays the same.

Industry talks about faster drill times, lower D&C costs. At the end of the day, the same money seems to be going into the system and nothing's coming out, where's the free cash flow? So, deductive reasoning tells you the money is trapped somewhere else in the system.

The right way to look at it is as a production system - from well scoping all the way to when the cash register starts to ring, then you optimize that system to reduce the time within and between each activity and task. If you try to optimize just one or two, you're going to create a bunch of bottlenecks in your system.

Please don't underestimate the time and cost of scoping – well scoping, planning and permitting. This is the engineers, these are land men. Engineers can often rework well designs two to three times before they're implemented. Land men have to go out and secure permits. It's a high cost – a lot of it just ends up in your G&A.



What is the size of this opportunity? Why should investors care? Here the slide shows one example of an onshore unconventional asset. This is in Texas, and this was an operator which looked at optimizing their current system.

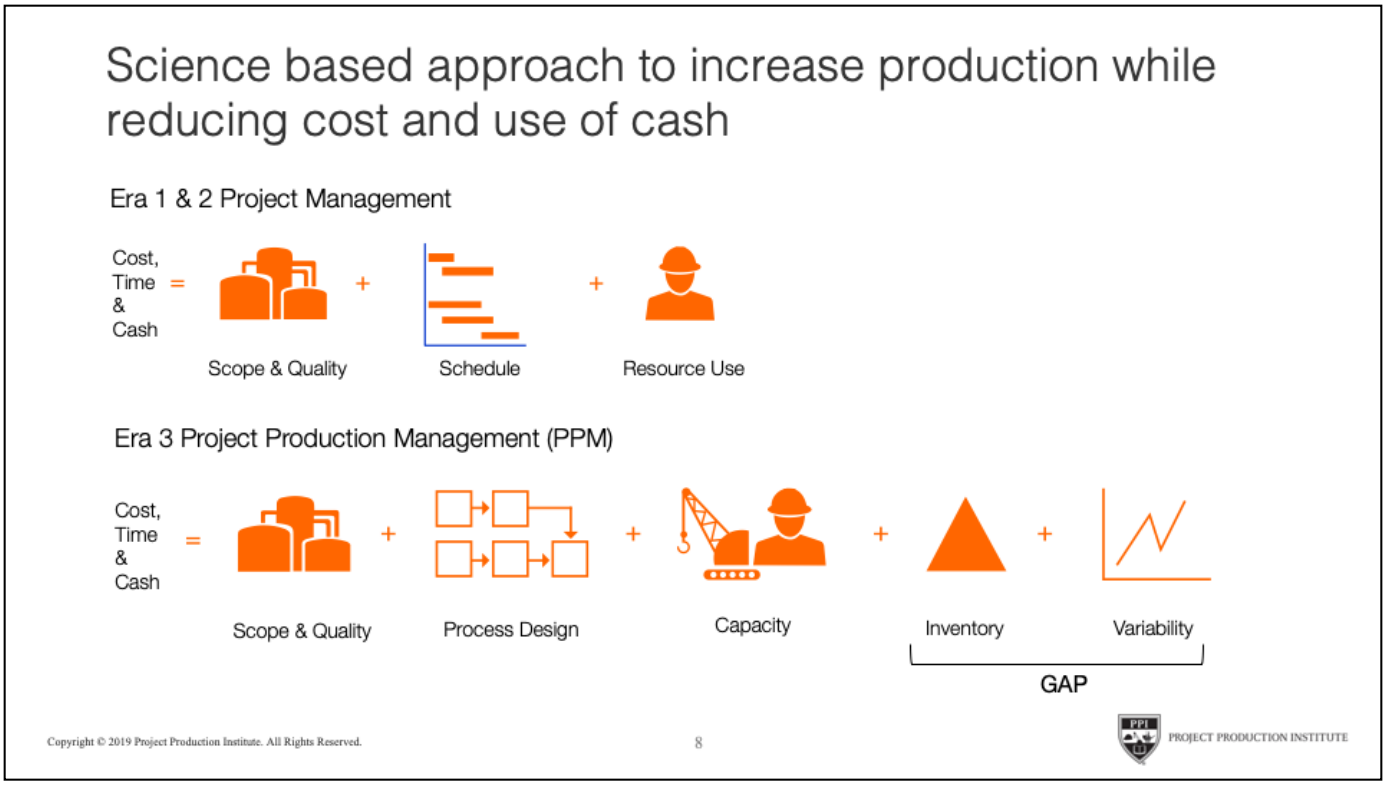
And what was found was that they could reduce their WIP – this is work in process, essentially inventory. They found it was possible to unlock $140 million of cash from their system.

From $215 million – they only needed $75 million of WIP in their system.

This reduction in WIP resulted in the cycle time to produce a well falling from 375 days to 125 days. And the annual capex then fell 21 percent to deliver the same number of wells.

There is a huge value opportunity here for the industry. And this is just one small operator.

Addressing the Gap



The first question is what is this gap that we've been talking about? You can see that we started using phrases like Era 1, Era 2 and Era 3. We're going to briefly describe what we mean by those things.

Era 1 is when the foundational ground work on how we think about productivity was developed. Era 2 emerged where the main focus of the thinking was unpredictability, where a lot of the practices the industry currently uses to manage projects were founded.

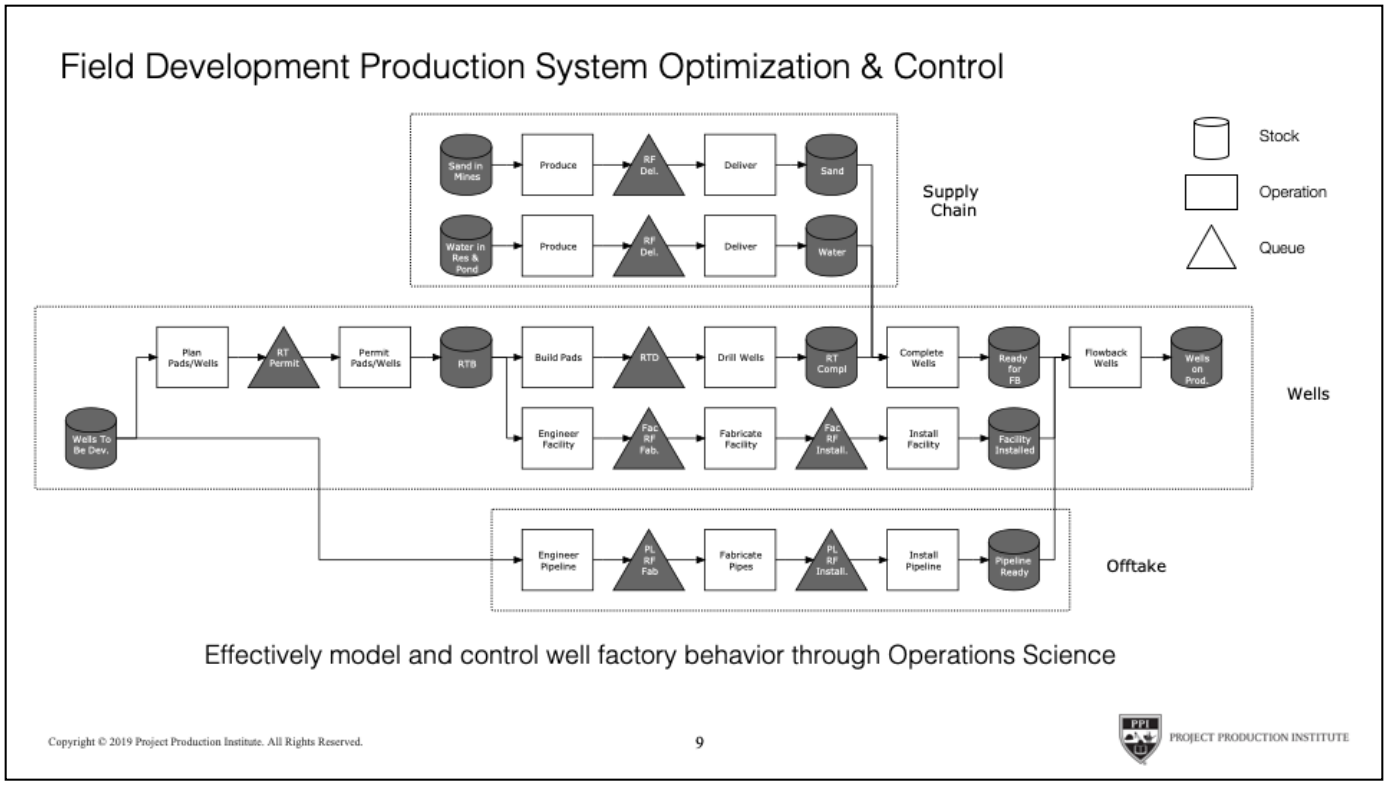
Era 1 and era 2 typically form the basis of how the industry actually manages the projects The key premise is that the cost, time and cash tied up in the system is a function of scope and quality, schedule and how the resource is used.

The relationship amongst these three is typically described using what's called an iron triangle - you want to improve the schedule, you've got to actually put more money into it. If you want to reduce the cost, you've got to give it more time. The old cost/time trade-off.

However, the current situation is not as simple. Many have experienced projects where the scope and quality deteriorated, schedule has overrun, and the cost has actually inflated. So, therefore, deductive reasoning suggests we are probably missing a couple of variables in describing what the real situation is.

We were able to find this by examining what's called operation science. The application of operations science to the project environment is what we're calling the project production management – Era 3.

When you actually look at it from the operation science perspective, two things that are not included in project management thinking are: inventory and variability.



To actually take a look at what that means, let's look at an example. Now, the same type of thinking applies, whether one is looking at major capital project turnaround, shutdowns, onshore field development, plug and abandonment.

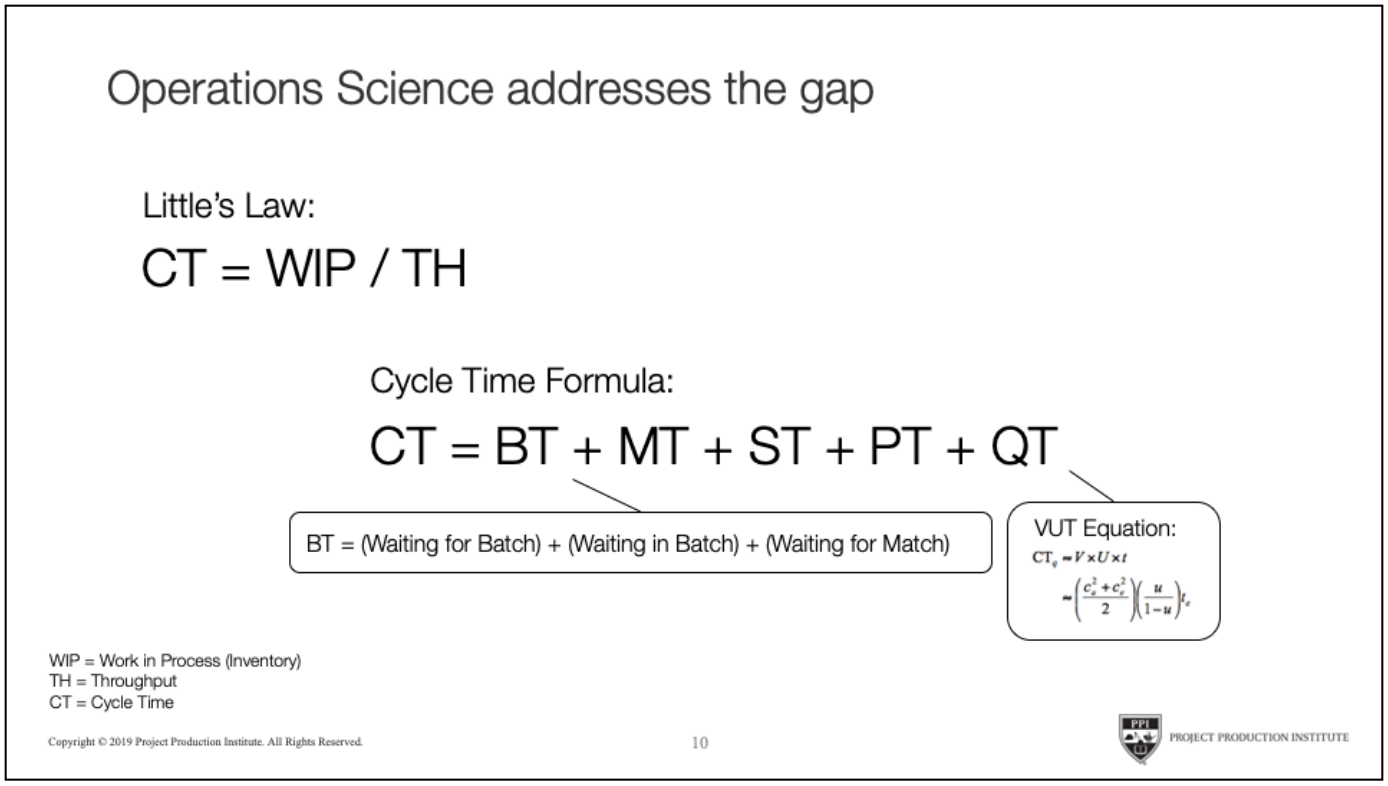
It applies to any type of project environment, but in this example, we will take a specific look at field development for oil delivery.

In the slide, one can see that there is the middle portion, which is about the delivery of the wells. The top of the graphic shows the supply chain, and at the bottom shows the design and delivery of the capacity.

One of the things that's not typically done in the industry is the differentiation of what is actually in the stack, versus what's in queue versus what's in operation.

So, there is no differentiation between wells that are waiting to be developed versus what are being developed, wells that are being completed, versus waiting to be completed.

By looking at it explicitly in these different buckets, one can start to see how the production system is going to behave. Once you actually map the production system as such, there are governing rules or laws that describe the behavior of the system, and put limits on its ultimate performance.



The first law is called Little's law. It can be written in two different forms. One way is to think of work in process as the throughput multiplied by the cycle time. The longer the cycle time, the greater the WIP. Therefore, one can actually think about WIP as the amount of cash trapped in the system.

The other way to look at Little's Law is the way it's written on the slide. The cycle time is WIP divided by throughput. The greater the WIP, the longer the cycle time. You can think about cycle time as the time it takes from well planning to when you actually generate the revenue.

When one examines cycle time, there are many ways people have tried to think about this. Some people have used words like value adding time, non-value adding time, non- value adding but necessary, but that's not really scientific. The only way that's scientific is to understand what constitutes a cycle time.

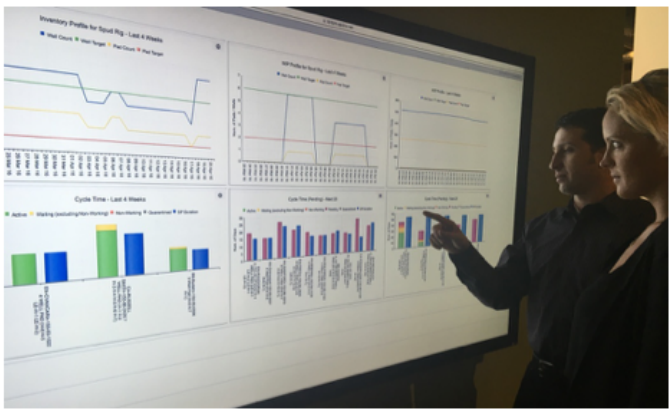
Examining the second formula, it says cycle time is batch time, move time, set up time, process time and queue time. And what's interesting is for any type of project, whether it's actually a major capital project or onshore field development, there's a constant tradeoff that's occurring between batch time and the set up time.

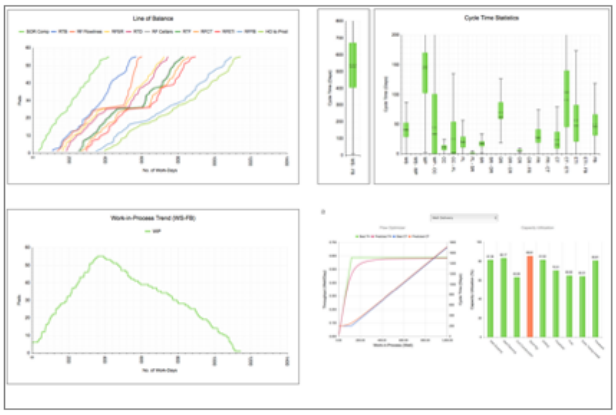
When operators start doing batch drilling, batch completions, that's actually an effort to minimize the set up time, by increasing the batch. However, this also increases the cycle time.

In a major capital project, there are similar tradeoffs. For example how do we actually maximize utilization of cargo space? How do we maximize utilization of our engineers versus how do we make sure that we are minimizing the cycle time?

And last but not least is the queue time. Queue time is the amount of time an item waits because the capacity isn't available. By focusing on productivity and utilization of resources, what the industry actually has done is increase the cycle time without knowing that it's actually doing so.

Field Development Production System Optimization and Control





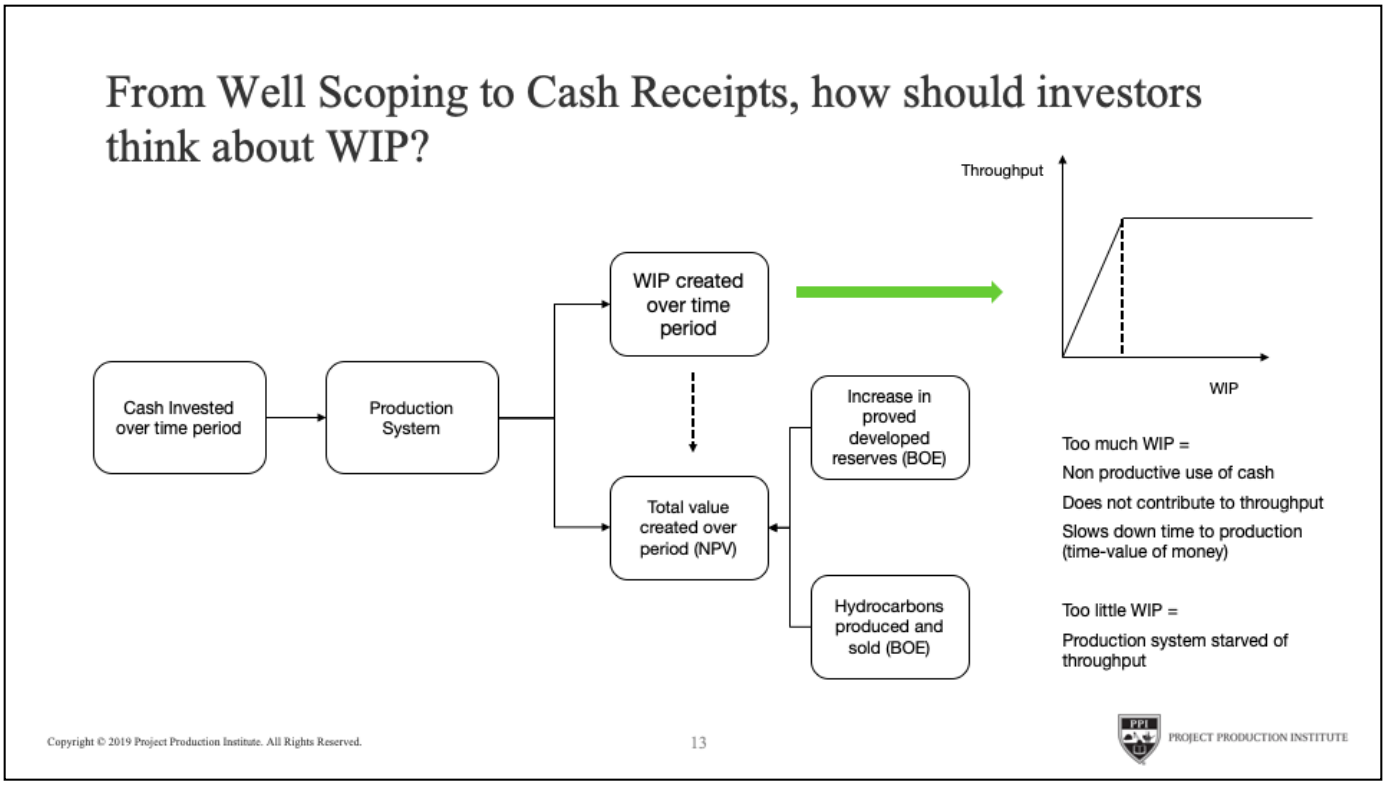
Production System Key Performance Indicators: Throughput (TH), Work-in-Process (WIP), Cycle Time (CT) and Capacity Utilization (CU)

PROJECT PRODUCTION INSTITUTE

We constantly see cases where operators have Improved the cycle time of individual operations; however, the end-to-end cycle time actually has not gone down, or in other cases, it actually has gone up. And that suggests they are not understanding the interplay of these factors.

So by understanding the production system, one can understand the diagrams shown on the right hand slde of the slide–what you're able to do is design your production system so that you are determining how it should behave, and then making sure you have some measurements and performance indicators that ensure it's actually working the way it's supposed to work.

Way Forward



What can investors do? Start thinking about WIP. To explain how WIP fits into the system, start at the left hand side of the chart. This is cash invested over the time period, capex, expenses, whatever – cash coming into the system.

The cash goes into the production system, if the investment is unconventional, it will be similar to the system that we discussed earlier; for an offshore project, LNG liquefaction, pipeline, that production system is a capital project.

The money in the system now, is split between WIP and value creation. WIP, think non-productive or pre-productive capital versus productive capital. And if you follow the green line over to the right, what we see is WIP versus throughput, with a little dotted line there.

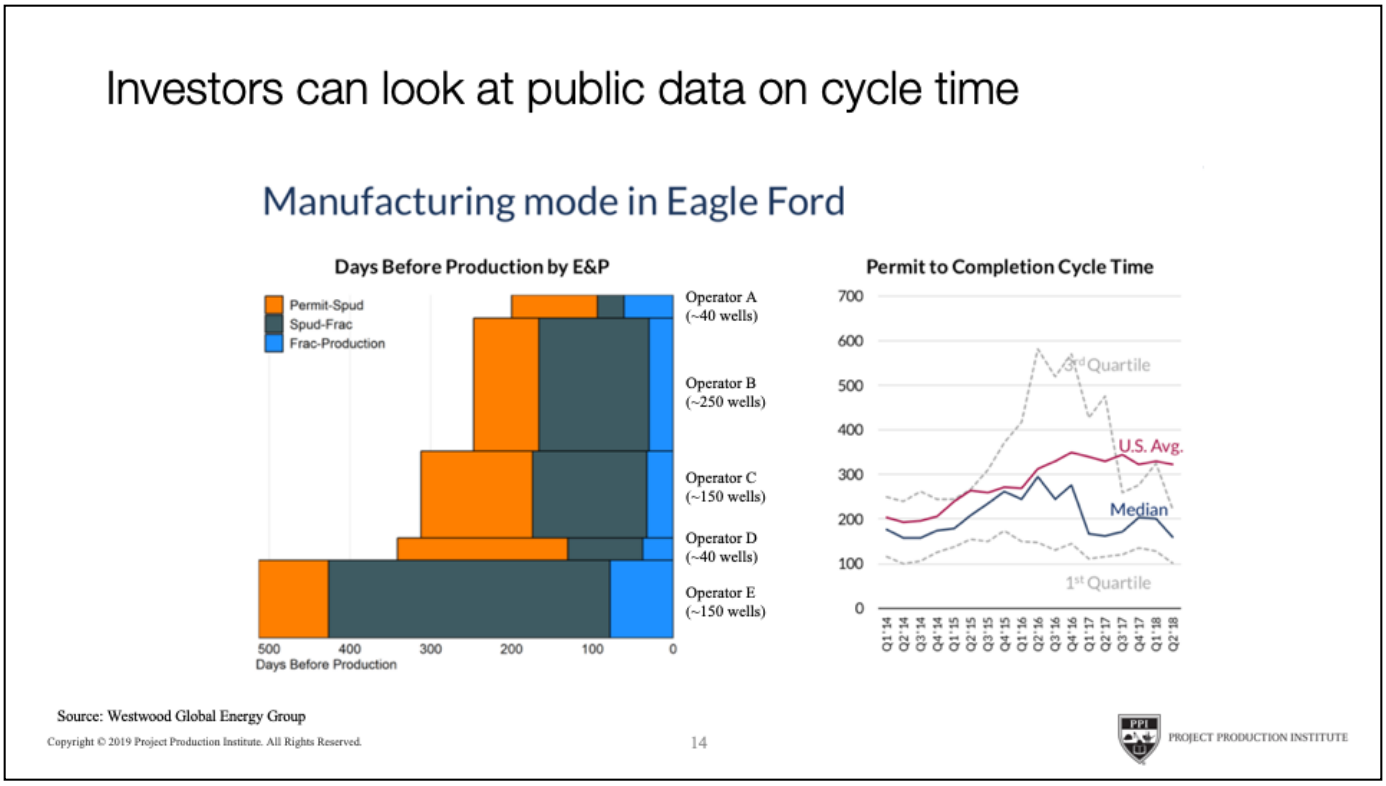
If you're to the right of that of that line, you have too much WIP in your system, you've got a lot of unproductive cash that's not contributing to throughput and you're slowing down time to production.

If you have too little, the production system is starved of throughput. So, you calculate the correct amount, and then that feeds down into your NPV or your valuation, which of course, is a derivation of PDPs and any existing production, which in and of itself, can be a separate production system.

It's very important to note that the correct level of WIP is not zero, but it is possible to calculate what it should be. Whatever that amount is, all of it shows up as an asset – on the balance sheet. And that's why you'll see a lot of write offs too, if people carry too much WIP over time, they end up writing it off.

In this industry, we so often assume that performance is linked to tight spacing, proppant, sub surface issues, rather than operational decisions like the optimum level of WIP. They can do this. They can actually dictate and control that.

How big is this WIP bucket? Well, we don't know for sure, but we can estimate some things, DUCs, drilled and uncompleted wells. We've got about 8,800 of those right now. That's about $20 billion of WIP right there. What's the appropriate amount? It's not 0, but what if it's $5 billion? There's $15 billion – that's investor money right there, tied up, not doing anything. And we saw in the earlier example that an E&P can easily have $140 million in excess WIP, before you even look at the reduction in capex.



For investors, we've got a couple of different analyses here that we've borrowed from various research institutions.

Here, we're looking at an example of data from Westwood Global Energy Group.

On the left, is a chart that shows the cycle time from permit to first production for five large operators in the Eagle Ford. We've covered up the names here to protect the innocent.

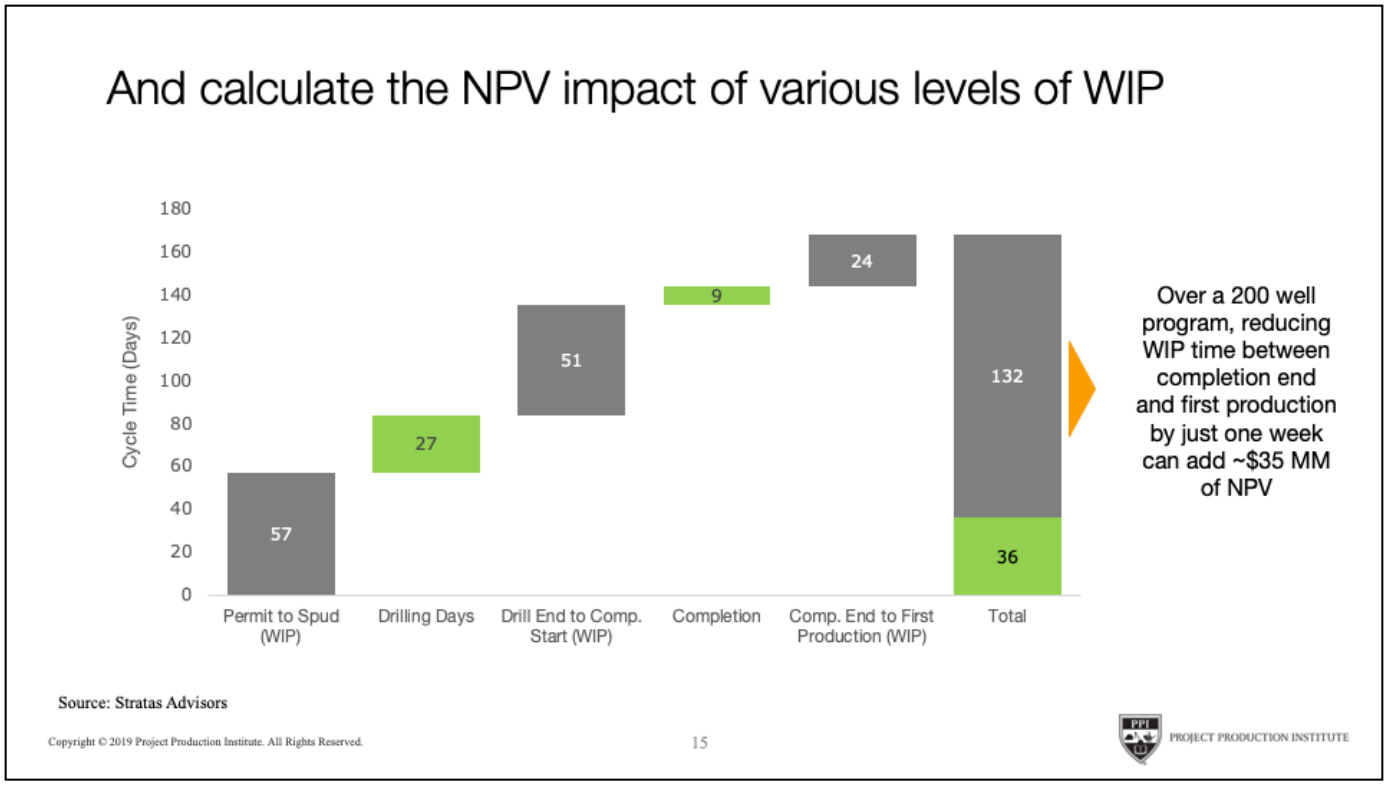
The width of the bars indicates the number of wells put on production. You can see that the cycle times vary widely. Zooming in on operators B and C, they've clearly optimized fracturing to first production time, but their overall time is not necessarily best in class.

Immediately – people's eyes tend to go to operator E. They must be carrying a lot of DUCs, right? Look at that huge gray bar of spud to fracture time.

If this represents about 150 wells, you're looking at $150 to $300 million of cash tied up in excess of – versus peers, 300 days more say. Compressing that time down would free up significant amount of cash and create huge NPV value. And the beauty of all this is that it is doable.

What if operator E changes its well design? They have to wait 500 days to push that new design through the system – so this is also about agility. The faster time I have to produce my wells, I can get new technology through the whole system faster. So, which operator is spending our money most efficiently?

This is analysis that you can do using public data. The little chart on the right shows the cycle time for the basin back to 2014, and you can look at it – they really haven't improved that much have they? Despite all the changes?



This an analysis from a research institution called Stratas Advisors. They're a part of Hart Energy.

In this example, they were isolating WIP for what appears to be pretty decent operator judging by their total cycle time.

The green boxes in the slide are the operation days. That's the drilling and completion activities. The gray boxes are essentially WIP. Remember that we don't want it to be 0, but at this point, we don't know what the correct number should be.

What Stratas found was that by removing seven days from that WIP, they could add $35 million of incremental value, NPV over the course of a 200 well program in one year. So, imagine reducing that by three, four, five weeks, now you're in $100, $150 million. That is a lot of value for just a one-year well program.

Further improvements to the green days are probably not going to do this operator much good. You've got to reduce the WIP time. And this is definitely a symptom of scheduling, the old era one and era two, where companies build in buffers between things which tend to be generous

So the takeaway here is that the industry likes to manipulate the subsurface and talk about spacing and type curves, when the reality is that they're not looking hard enough at what they can be doing above ground.

What can you do?

Institutional Investors	Use public data to benchmark cycle time and well costs by operator and play. Public data is flawed but will give an indication of the size of the problem for the operator. Also look at variability of time and cost – higher variability is bad Ask Questions: How much WIP do you have and what is your ideal level? What is your average cycle time to bring a well on production from planning/scoping to first production? What is the high and the low? Has it improved over time? If not, why? Why optimize drilling days, for example, but still take 300 days to produce a well? How much non-productive capital is currently tied-up onshore?
Private Equity	When building your company, implement project production management up front Implement for portfolio companies to improve profitability and speed up exit
Oil and Gas Operators	Prepare for investor questions on WIP and variability Test your current system to see what can be achieved if optimized

What can an investor do? Here we just laid out a few different things.

First, for investors, go look at the public data on time, on costs, and you can even look at the ninetieth and tenth percentile of their wells – look at 100 wells or so that somebody has drilled.

You can look at the variability between the fastest and slowest time. Companies with high variability always have excess WIP.

Once you have this information, you can ask the operators more pointed questions about what they're going to do about it.

For any private equity institutions when you're investing in a company, you should always optimize their system. It can provide immediate value to you. It'll also help enable the portfolio companies to become more profitable, hopefully speeding up your exit, if that's your goal.

For operators - you should have a clear understanding of what you're doing internally, so that you can be prepared to answer questions from investors.

You could also quite easily test your current system.

To Learn More

Project Production Institute: https://projectproduction.org

PPI is underwriting a free research project to benchmark field development and project production systems for those operators that want to participate

Contact Amanda Goller: agoller@projectproduction.org

Or reach out to Bob Brackett: bob.brackett@bernstein.com

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