The Use of Drones in the Oil and Gas Industry: A 4.0 Contract[1, 2]

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ABSTRACT

Over the past few years, the Oil and Gas industry has been evolving and has gone through significant legislative reform. With more and more environment, safety and security issues arising from this industry, we introduced new technologies projects such as Unmanned Aircraft Systems (UAS). This paper aims at understanding what regulation barriers the UAS faces. We identified the contractual progress that has been made in implementing this technology and evaluated how regulations needed to change.

Using different methodologies such as Root Cause Analysis, as well as quantitative and qualitative analysis, we were able to answer the question: How using drones in the Oil and Gas Industry can be a real challenge to contract? We understood how companies were technologies reluctant and we identified that a really effective manner to facilitate this process was to study international legislation and rules in which UAS are implemented and use it as best practice and guidelines.

Technology, with its exponential growth, needs to be regulated and implemented easily. It's about considering sustainability, our safety, and the preservation of our environment.

Keywords: Oil and Gas industry, Drone Inspections, FAA Regulations, Technology, Copyright Law

INTRODUCTION

What does the Oil and Gas Industry mean to all of us? Mainly fuel, plastic and heaters. But if we take a look behind the scenes, this industry is also: "$37 billion a year spent by the market in monitoring Pipeline leaks[3]"; "200 thousand miles of oil pipelines to inspect"[4],

[1] Editor's note: This paper was prepared for the course "International Contract Management" facilitated by Dr Paul D. Giammalvo of PT Mitratata Citragraha, Jakarta, Indonesia as an Adjunct Professor under contract to SKEMA Business School for the program Master of Science in Project and Programme Management and Business Development. http://www.skema.edu/programmes/masters-of-science. For more information on this global program (Lille and Paris in France; Belo Horizonte in Brazil), contact Dr Paul Gardiner, Global Programme Director, at paul.gardiner@skema.edu.

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[3] *Bernos, M. (2017, April 19). Canadian Company Proposes to Cut Pipeline Monitoring Costs with Automated Drones. https://www.enr.com/articles/41865-canadian-company-proposes-to-cut-pipeline-monitoring-costs-with-automated-drones*

[4] *Lack, S. (2016, September 25). There's More to Pipelines Than Oil. https://sl-advisors.com/theres-pipelines-oil*

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"166,8 thousand of employees, 1501 cases of injuries and illness, 9 fatalities reported, just in the U.S., in 2016."[5]

One of the main challenges for Oil and Gas companies is maintaining their infrastructures in optimal conditions. In order to do that, they use traditional asset inspections which are revealed to be:

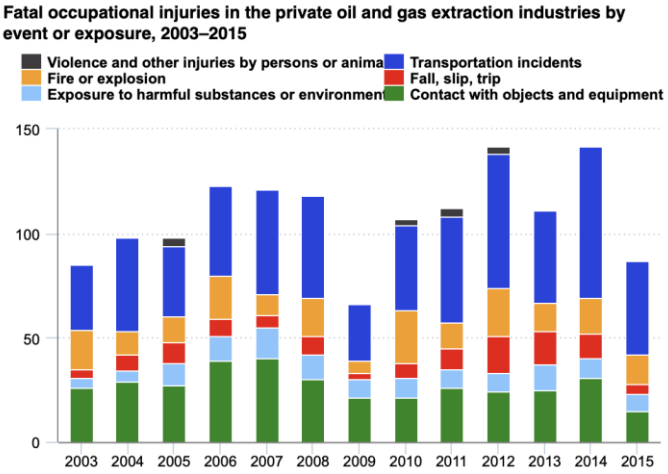
Dangerous: Companies use human means to make inspections, which can be highly unsafe (risk of industrial accidents, health issues, etc.). Oil and gas extraction industries made up "74 percent of the total fatalities in the mining sector in 2015".[3]

Performed in Inaccessible areas: Employees find themselves in risky situations such as being up on ladders or ropes, in helicopters, in the middle of the sea, and other perilous areas. In operations and maintenance, for example, using caged drones for confined spaces where there wouldn't be any human, could lead to a quicker deployment.

Costly: These inspections generate high costs by the use of expensive material means, downtime, etc.

Time consuming: It takes time (planning, time required to erect ladders, access towers, swing stages, aerial lifts, and other heavy equipment).

Inaccurate: Traditional methods retrieve millions of data, but they are more likely to produce inaccurate data due to human error.



Source: U.S. Bureau of Labor Statistics.[6]

[5] *Bureau of Labor Statistics. (2017, July 7). Fact Sheet - Mining, Quarrying, and Oil and Gas Extraction - July 2017 https://www.bls.gov/iif/oshwc/cfoi/mining-fact-sheet.htm*

[6] *Bureau of Labor Statistics. (2017, July 7). Fact Sheet - Mining, Quarrying, and Oil and Gas Extraction - July 2017 https://www.bls.gov/iif/oshwc/cfoi/mining-fact-sheet.htm*

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All of those factors lead companies to consider using drone technology to transform radically their inspection activities. Indeed, it allows the Increase of worker safety by minimizing the obvious dangers and health risks. Drone inspections is a project that considerably reduces risk for employees in the field, especially the inspections of facilities such as oil and gas refineries, flare stacks, and pipelines. It also enables the collection of, in-depth and higher detail data, increases the speed of delivery and reduces inspection expenses. A method that also drives a more optimized data reporting process and help industries improve inspection routine efficiency.

The Drone Market Potential cannot be ignored any longer, drones for site inspections is one of the top 5 innovative technologies projects for 2018. "Its annual growth rate is evaluated at 17,5% from 2017 to 2024"[7]. "In a recent report, professional services consultancy PwC, valued the addressable market of drone-powered solutions in the power and utilities sector at $9.46 billion". [8]

It appeared like the perfect alternative, yet, drone inspections are still underused. Adoption has been slower than expected. Some of the companies revealed to be new technologies reluctant, but this wasn't the only cause. One of the reasons explaining that failure, is the many regulatory barriers it faces. Indeed Regulations, which sometimes differ significantly from country to country, are also a challenge. The second biggest issue arising from that technology is Data protection, which is still particularly not well defined and regulated within contracts.

Step 1 – Problem definition

Five questions can arise from this research as shown in Figures 1:

[7] *Mazur, M. (2017, October). Clarity from above, Leveraging drone technologies to secure utilities systems*

[8] *Bayar, T. (2018, February 23). How drones are playing a role in the power and utility sector https://www.powerengineeringint.com/articles/2018/02/how-drones-are-playing-a-role-in-the-power-and-utility-sector.html*

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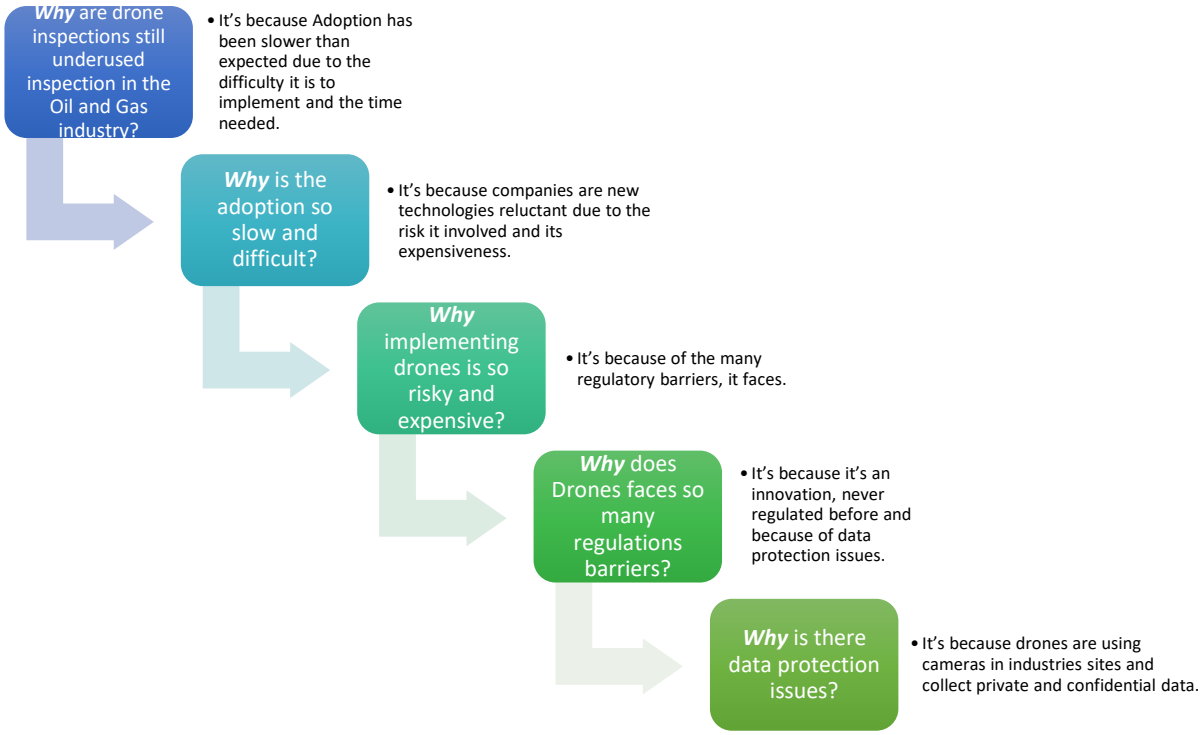

Figure 1 – Root Cause Analysis, Using the 5 Whys Method [9]

This paper aims at understanding what regulation barriers the Unmanned Aircraft System (UAS), usually known as Drones, faces. Then, to identify and analyze, the contractual progress that has been made in implementing this technology. Finally, to evaluate in what ways UAS regulations need to change for drone use to prosper?

Considering this, we will be able to answer the question: How using drones in the Oil and Gas Industry can be a real challenge to contract?

METHODOLOGY

Step 2 – Feasible Alternatives Solutions identification

After understanding what regulation barriers that the Unmanned Aircraft System (UAS) usually faces, we will be able to identify three possible alternatives facilitating the implementation of drone technology in the Oil and Gas industry:

1. Enforce safety directives for drone operators
2. Beyond-visual-line-of-sight operations need to be tested and implemented

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3. Industries and governments need to regulate air safety and security
4. International Drones Legislation Comparison

In order to assess each alternative, we used the 5 Whys Root Cause Analysis Method to develop six attributes we will measure:

1. Cost
2. Risk
3. Ease of Implementation
4. Time
5. Fit-for-purpose
6. Reusability

Step 3 – Development of the Outcomes for alternatives

We've identified four alternatives that can be taken into consideration to face the problematic:

1. Enforce safety directives for drone operators

The Federal Aviation Administration (FAA) should mobilize more people in this project and it needs to focus on regulating the UAS market.[10] Three methods are identified, today:

1 - "compliance actions" involving training and corrections.

2 - "administrative actions" and "enforcement actions" involving a letter of correction or warning and civil penalties or revoked licenses.

2. Beyond-visual-line-of-sight operations should be tested and implemented

We must make "beyond-visual-line-of-sight" operations possible. These operations are currently prohibited. Without this alternative, some possibilities of drones use, such as oil and gas site inspections, will be impossible to test and set up. The FAA regulates all drones operations, both off and onshore.[11] Drone inspections can be used outdoor, indoor and offshore. Drones are submitted to a restriction of flying at an altitude of 100 meters. However, some companies are allowed to perform inspections higher.

There is always a drone pilot present during drone inspections because of safety procedures and local regulations. However today, thanks to the evolution of drone

[10] *Bean, T. (2018, July 14). 3 ways regulations need to change for the drone industry to take off. https://thenextweb.com/contributors/2018/07/14/3-ways-regulations-need-to-change-for-the-drone-industry-to-take-off/*

[11] *Federal Aviation Administration. (2017, October 27). FAA Regulations. https://www.faa.gov/regulations_policies/faa_regulations/*

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technology like navigation systems, we are able to inspect without continuous presence of a pilot.

3. Industries and governments should regulate air safety and security

Industries and governments must seriously consider aviation safety issues. With this technology, malicious people could see high-risk places, such as prisons, power plants, or government buildings. They could also collect confidential data from industrial sites and publish it to the public or to competitors. Public safety is also a major concern when it comes to using drones.

To ensure safety, the aerial areas that will need to be protected should be specified. It will also be necessary to regulate the possible destruction of potentially dangerous content and data, usually pictures or videos.

4. International Drones Legislation Comparison

Research other countries legislation and rules in which UAS are implemented and use it as best practice and guidelines. Indeed, other countries like the United Kingdom or the U.S., already have drone inspections implemented. By comparing the other legislation from other countries or other industries, we could use them in order to implement it in the Oil and Gast industry.

Step 4 – Selection of the criteria

In order to analyze the four alternatives detailed earlier, and to be able to decide which one appears to be the most appropriate to help implement Drones in the Oil and gas industry, we use a multi-attribute decision model (MADM) to eliminate any poor alternative.

In this section, we identified six attributes to consider the alternatives stated above:

- The **cost** for the FAA: we can take into consideration the cost of mobilizing an entire team to implement these new regulations.

- The **risk** taken by the company: we can take into consideration the risk if the contract does not meet all the legal requirements.

- The **ease of implementation**: we can consider the efforts needed to produce and execute the alternative.
- The **time** needed by the company to implement: we can consider the time needed for the negotiation, the elaboration of such an alternative.

- The **fit-for-purpose** for the company: we can consider the relevance and uniformity of the alternative.

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- The **reusability** of the contract: we can consider if this alternative can be used in different contexts/situations. For example, for other new technologies such as the Internet of Things (IoT).

Attributes	Alternative 1 Enforce Safety Directives	Alternative 2 Allow beyond-visual-line-of-sight	Alternative 3 Regulate Air Safety and Security	Alternative 4 International Drones Legislation Comparison
Cost	Poor	Fair	Fair	Excellent
Risk	Fair	Poor	Poor	Good
The Ease	Fair	Poor	Good	Excellent
Time	Poor	Poor	Poor	Fair
Fit-for-purpose	Excellent	Fair	Excellent	Fair
Reusability	Good	Fair	Good	Fair

Figure 2 – Qualitative Analysis[12]

This MADM table follows a color code and quantitative indications, which correspond to:

– A green score indicates positivity of the attribute
– A yellow score indicates that the global fairness of the attribute
– A red score indicates negativity of the attribute

The minimum acceptable criterion, in order to pursue the analysis, are:

- To have no red-coded attribute for the alternative.
- To have at least one green box.

So, based on the matrix analysis table above, we can narrow the choice of alternative by eliminating the second alternative. The "Allow beyond-visual-line-of-sight" alternative has 3 red-coded attributes and implies high risks, a large amount of time and difficulties in implementation.

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FINDINGS

Step 5 – Analysis and comparison of the alternatives

Since we eliminated the second alternative, we can now compare the alternatives remaining. In order to select the best alternative for the implementation of drones in the Oil and Gas industry, we provide a quantitative analysis with the relatively weighted technique.

We will keep the attributes stated previously in Table 1. To perform the weighted product model, we convert the previous color code and qualitative classification into a quantitative analysis.

We can use this conversion:

- Excellent = 1
- Good = 0,67
- Fair = 0,33
- Poor = 0

Attributes	Alternative 1 Enforce Safety Directives	Alternative 3 Regulate Air Safety and Security	Alternative 4 International Drones Legislation Comparison
Cost	0	0.33	1
Risk	0.33	0	0.67
The Ease	0.33	0.67	1
Time	0	0	0.33
Fit-for-purpose	1	1	0.33
Reusability	0.67	0.67	0.33
SUM	2.33	2.67	3.66

Figure 3 – Quantitative Analysis[13]

From this quantitative table, we obtain, we can eliminate the first alternative, which has the lowest sum. We can now compare the third and fourth alternative in correspondence with the attributes that are significative to companies.

To best analyze the alternatives remaining and their added value to this Unmanned Aerial Vehicle (UAVs) project, we produce an additive weighting model.

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Attributes	Step 1	Step 2			Alternative 3 Regulate Air Safety and Security		Alternative 4 International Drones Legislation Comparison	
	Relative rank	Normalized Weighted (A)			(B)	(A)x(B)	(C)	(A)x(C)
Cost	2	2/21	=	0.10	0.33	0.03	1	0.10
Risk	4	4/21	=	0.19	0	0	0.67	0.13
The Ease	5	5/21	=	0.24	0.67	0.16	1	0.24
Time	3	3/21	=	0.14	0	0	0.33	0.05
Fit-for-purpose	1	1/21	=	0.05	1	0.05	0.33	0.02
Reusability	6	6/21	=	0.21	0.67	0.14	0.33	0.07
SUM	21		SUM	1	SUM	0.38	SUM	0.61

Figure 4 – Additive weighting model analysis[14]

Step 6 – Selection of the preferred alternatives

Using the tables 1 and 2, we may observe that the rank of the attributes indicates what is important to companies, and in what ways the alternatives identified are responding to it. From the relatively weighted technique shown in Table 3, the fourth alternative is better than the third. Considering 3.66/2,67 = 1,37 and 1,37 ∗ 100 = 137%, the fourth alternative is 137% times better than the third one.

Now, if we take into account that importance of the specified attributes and use the table 3 with the additive weighted technique. Considering 0,61/0,38 = 1,60 and 1,60 ∗ 100 = 160 %, we may identify the fourth alternative as better than the third one, by 160%, this time.

According to both tables, the fourth alternative, researching other countries legislation and rules in which UAS are implemented and use it as best practice and guidelines, is recommended.

After analyzing these results, even if the fourth alternative is preferred, we are able to provide a final ranking of alternatives:

1- Alternative 4: International Drones Legislation Comparison
2- Alternative 3: Regulate Air Safety & Security
3- Alternative 1: Enforce Safety Directives
4- Alternative 2: Allow beyond-visual-line-of-sight

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Step 7 – Performance monitoring and post-evaluation of results

In order to follow up on the project, we can produce a Before and After Pareto Analysis. We will specify and measure any problems before analyzing and ranking them in a table, by order of importance. Then, we will score each identified problem and group them.

Using the information retrieved, we will produce an action plan and formulate any performance improvement actions. Afterward, we will be able to face each problem by their priority, for example, by making a Return on Investment (ROI) analysis.

Type of problem	Number of times	% of total	Number of problems (cumulative)	% (cumulative)
Problem 1	350	38,25%	350	38%
Problem 2	298	32,57%	648	71%
Problem 3	140	15,30%	788	86%
Problem 4	35	3,83%	823	90%
Problem 5	27	2,95%	850	93%
Problem 6	20	2,19%	870	95%
Problem 7	19	2,08%	889	97%
Problem 8	15	1,64%	904	99%
Problem 9	9	0,98%	913	100%
Problem 10	2	0,22%	915	100%
Total	**915**	**100,00%**	**915**	**100%**

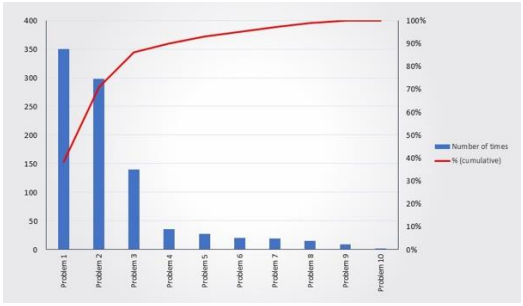

Figure 5 – Pareto Analysis Chart & Diagram[15]

CONCLUSION

We are all directly concerned with environment, safety or security issues. With more and more problems arising from huge industries like Oil and Gas, new technologies projects such as Drones revealed to be a real solution to face them.

Drone for site inspections considerably reduce risk for employees in the field, reduce inspections expenses and help industries improve inspection routine efficiency and quality of data acquisitions.

Therefore, it became inevitable and necessary to facilitate the implementation of these technologies within industries, especially in terms of contracts and legislation, to make them sustainable.

In this paper, we aimed to understand what regulations barriers the Unmanned Aircraft System (UAS), usually known as Drones, faces. Our objective statement was to answer these two questions:

- In what ways UAS regulations need to change for the drone use to prosper?
- How using drones in the Oil and Gas Industry can be a real challenge to contract?

[15] *Mulder, P. (2012). Pareto Analysis and principle. Retrieved [insert date] from ToolsHero: https://www.toolshero.com/problem-solving/pareto-analysis/*

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In the first place, we understood how the alternatives identified can be a real challenge to contract, in term of complexity in implementation, risk, time, cost and reusability.

On the other hand, in order to understand in what ways UAS regulations needed to change, we developed four alternatives: negotiating an existing contract, creating flexible contracts and making an informal change. Using different methods of analysis and comparison, we determined that the fourth alternative is preferred. Indeed, studying international legislation and rules in which UAS are implemented and use it as best practice and guidelines, seems to be the less costly, risky and the easiest to implement rapidly.

The main focus here is: To move from a time-based decision making to a data-based decision making. This, by providing a way to collect and process data of all inspection activities, using drone technology.

Technology will never cease to evolve, by facilitating their implementation, we can move from a fragile industry to a sustainable one.

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Penda Sow is a French student, who after 3 years of studies in Economics is now currently enrolled in a Master of Science specialized in "Project and Programme Management and Business Development for Business Excellence" at SKEMA Business School in Paris. She is strongly interested in design and new technology projects, especially in artificial intelligence or cognitive sciences. Passionate about travels and photography, she discovers the world as soon as she has the opportunity (Spain, England, Italy, Thailand, Peru, Bolivia, Cambodia, Malaysia, China, USA, Senegal).

She enjoys generating new ideas, doing research and development, improving processes or renewing products and services. Her experience as a product manager in a software provider firm strengthened her willingness to involve herself in innovative and sustainable projects.

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