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Analyse bibliométrique de la publication : "How to use Big Data technologies to optimize operations in Upstream Petroleum Industry"

Abdelkader Baaziz

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Analyse bibliométrique de la publication

How to use Big Data technologies to optimize operations in Upstream Petroleum Industry

Comment utiliser les technologies des Big Data pour optimiser les opérations dans l'activité Amont de l'industrie pétrolière

Abdelkader Baaziz
Janvier 2020

Analyse bibliométrique de la publication :

How to use Big Data technologies to optimize operations in Upstream Petroleum Industry

Comment utiliser les technologies des Big Data pour optimiser les opérations dans l'activité Amont de l'industrie pétrolière

1. Présentation générale de la publication

Cette publication est parue dans la revue « International Journal of innovation »⁽¹⁾ dédiée au management de l'innovation, une discipline **pluridisciplinaire** revendiquée par différents domaines des sciences humaines (aussi bien en sciences de gestion qu'en sciences de l'information) mais aussi des sciences du vivant et des sciences de l'ingénieur.

International Journal of innovation (IJJ Journal) est un journal **Open Access**, sans frais de publication, à comité de lecture de type « peer review » et qui respecte les bonnes pratiques et normes éditoriales d'une revue de recherche. Malgré le jeune âge de ce journal, né en 2013, il est déjà, répertorié dans les diverses bases scientifiques :

- Web of Science Core Collection (Emerging Sources Citation Index),
- Directory of Open Access Journals (DOAJ),
- ERIH Plus,
- EBSCO Host,
- PROQUEST,
- Red de Revistas Científicas de América Latina y el Caribe, España y Portugal (REDALYC);
- Portal de Portales LATINDEX,
- OpenAire,
- Gale Cengage Learning,
- DIALNET,
- Red Iberoamericana de Innovación y Conocimiento Científico,
- Système de classement brésilien QUALIS – B2 (Business Management)

Ce papier a également été présenté (avec l'accord préalable de IJJ Journal), au 21ème Congrès Mondial du Pétrole (21st World Petroleum Congress) qui s'est déroulé à Moscou (Russie) en Juin 2014.

World Petroleum Congress (WPC) est depuis **1933**, l'événement majeur et d'envergure mondiale réunissant les grands acteurs du secteur de l'énergie, notamment du pétrole et du gaz⁽²⁾. Il regroupe les compagnies et agences pétrolières et gazières nationales et internationales, les plus prestigieuses du monde. Il est organisé par le World Petroleum

¹ Publication consultable en Open Access au lien @ <http://www.journaliji.org/index.php/iji/article/view/4> [Consulté le 20/01/2020]

² Site Web de Total @ <https://www.total.com/fr/dossiers/futur-de-lenergie-total-au-world-petroleum-congress> [Consulté le 20/01/2020]

Council (WPC) ⁽³⁾, une organisation internationale représentant le secteur pétrolier dans le monde entier.

Cette publication a fait l'objet (jusqu'en date du 19/01/2020) de :

- 25 citations dans des publications indexées dans Web of Science,
- Au moins 18 citations recensées dans des publications indexées dans Scopus,
- 67 citations dans des publications référencées sur Google Scholar,
- 44 citations dans des publications référencées sur ResearchGate,
- 02 citations dans des études prospectives publiées par le cabinet conseil « Deloitte »,
- Plusieurs citations dans des revues spécialisées dédiées aux professionnels du Pétrole,
- Plusieurs autres publications et communications (dont les citations sont mal-mentionnées ou non-conformes aux standards).
- Plusieurs études, thèses de doctorat et mémoires de master (dont les résultats n'apparaissent pas systématiquement sur Google Scholar et/ou sur les autres bases).

La publication a fait l'objet de trois (03) actes de plagiat, en Inde, en Chine et en Azerbaïdjan !

2. Citations de la publication dans Web of Science

La publication est citée par vingt-cinq (25) travaux référencés dans les bases de données du Web of Science (WoS), désormais « Clarivate Analytics ».

The screenshot shows the Web of Science search results page. The search criteria are: CITED AUTHOR: (Baaziz) AND CITED TITLE: (How to use Big Data technologies to optimize operations in Upstream Petroleum Industry). The results are sorted by Date. The first five results are:

1. Time-based responsive logistics for a maintenance service network A case study of an automated teller manufacturer. By: Manikas, Ioannis; Sundarakani, Balan; Iakimenko, Vera. JOURNAL OF QUALITY IN MAINTENANCE ENGINEERING Volume: 25 Issue: 4 Pages: 589-611 Published: OCT 2 2019.
2. Association Analysis of Piping Materials of an Offshore Structure Using Big Data Technology. By: Park, Sung-Woo; Roh, Myung-Il; Oh, Min-Jae; et al. JOURNAL OF SHIP PRODUCTION AND DESIGN Volume: 35 Issue: 3 Pages: 220-230 Published: AUG 2019.
3. Multi-model Databases: A New Journey to Handle the Variety of Data. By: Lu, Jiaheng; Holubova, Irena. ACM COMPUTING SURVEYS Volume: 52 Issue: 3 Article Number: 55 Published: JUL 2019.
4. Framework for parallelisation on big data. By: Ab Rahim, Lukman; Kudiri, Krishna Mohan; Bahattacharjee, Shiladitya. PLOS ONE Volume: 14 Issue: 5 Article Number: e0214044 Published: MAY 23 2019.
5. A framework for shopfloor material delivery based on real-time manufacturing big data. By: Ren, Shan; Zhao, Xibin; Huang, Binbin; et al. JOURNAL OF AMBIENT INTELLIGENCE AND HUMANIZED COMPUTING Volume: 10 Issue: 3 Special Issue: SI Pages: 1093-1108 Published: MAR 2019.

Figure 1. Les résultats de la requête effectuée lors de la recherche des citations

³ WPC sur Wikipédia @ https://en.wikipedia.org/wiki/World_Petroleum_Council [Consulté le 20/01/2020]

Ce résultat est obtenu par l'intermédiaire de la requête lancée dans WoS :

"CITE AUTHOR" = (Baaziz) AND "CITE TITLE" = (How to use Big Data technologies to optimize operations in Upstream Petroleum Industry).

The screenshot shows the Web of Science search interface. At the top, there are navigation links for 'Web of Science', 'InCites', 'Journal Citation Reports', 'Essential Science Indicators', 'EndNote', 'Publons', and 'Kopernio'. The main header includes 'Web of Science' and the 'Clarivate Analytics' logo. Below the header, there are options for 'Tools', 'Searches and alerts', 'Search History', and 'Marked List'. A dropdown menu for 'Select a database' is set to 'All Databases'. The search type is 'Cited Reference Search'. The search criteria are: 'Cited Author' (Baaziz) and 'Cited Title' (How to use Big Data technologies to optimize operations in Upstream Petroleum Industry). There is also a 'Cited Year(s)' field with an example '1943 or 1943-1945'. A 'Search' button is visible, along with a link to 'View our Cited Reference Search tutorial'. A 'Timespan' dropdown is set to 'All years (1950 - 2020)'.

Figure 2. La requête effectuée lors de la recherche des citations

Les résultats ont été trouvés dans 04 bases différentes du WoS et se présentent comme suit :

La base consultée	Nombre de citations	Langues
Web of Science Core Collection	24	Anglais
Current Contents Connect	08	Anglais
MEDLINE®	01	Anglais
Russian Science Citation Index	01	Russe

Tableau 1. Le nombre de références qui citent notre publication par type de base consultée sur WoS.

La figure 3 montre que les citations trouvées dans WoS, sont réparties en vingt-cinq (25) disciplines différentes :



Figure 3. La répartition (en nombre) des références qui citent notre publication par disciplines.

Cette répartition illustre parfaitement la pluridisciplinarité de notre publication. Elle montre aussi, que la publication joue son rôle clef de « médiation scientifique » auprès des chercheurs des différentes disciplines énumérées.

Répartition par domaines de la recherche :

Domaine de la recherche	Nombre de citations
Sciences et Technologies	23
Sciences Humaines et Sociales	08

Tableau 2. Le nombre de références qui citent notre publication par domaines de recherche.

Le nombre total de citations est supérieur au nombre de citations effectives du fait que certaines conférences ou journaux multidisciplinaires, sont classés dans plusieurs domaines de recherches.

Research Domains ▲

SCIENCE TECHNOLOGY (23)

SOCIAL SCIENCES (8)



Figure 4. Liste des sources indexées dans WoS où les travaux citant notre publication, sont diffusés

Il faut noter que plusieurs auteurs qui ont cité notre publication, ont diffusé leurs travaux dans des revues à haut impact factor et classés selon « Journal Citation Reports » dans le Q1 ou Q2 de leurs disciplines respectives (figures 5.A – 5.F).

INDUSTRIAL & ENGINEERING CHEMISTRY RESEARCH

Impact Factor
3.141 3.284
2017 5 year

JCR @ Category	Rank in Category	Quartile in Category
ENGINEERING, CHEMICAL	33 of 137	Q1

Data from the 2017 edition of Journal Citation Reports

Publisher
AMER CHEMICAL SOC, 1155 16TH ST, NW, WASHINGTON, DC 20036 USA

ISSN: 0888-5885

Research Domain
Engineering

Close Window

Figure 5.A

ACM COMPUTING SURVEYS

Impact Factor
6.131 9.227
2018 5 year

JCR @ Category	Rank in Category	Quartile in Category
COMPUTER SCIENCE, THEORY & METHODS	6 of 105	Q1

Data from the 2018 edition of Journal Citation Reports

Publisher
ASSOC COMPUTING MACHINERY, 2 PENN PLAZA, STE 701, NEW YORK, NY 10121-0701 USA

ISSN: 0360-0300
eISSN: 1557-7341

Research Domain
Computer Science

Close Window

Figure 5.B

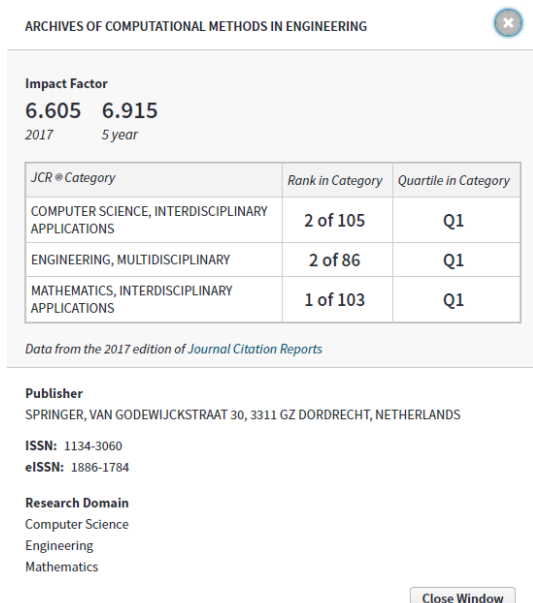


Figure 5.C

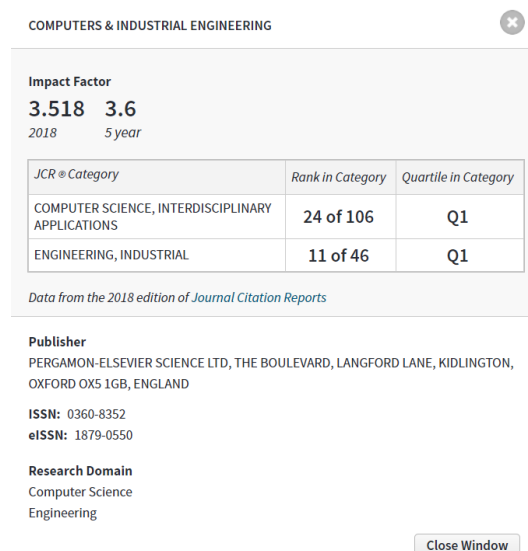


Figure 5.D

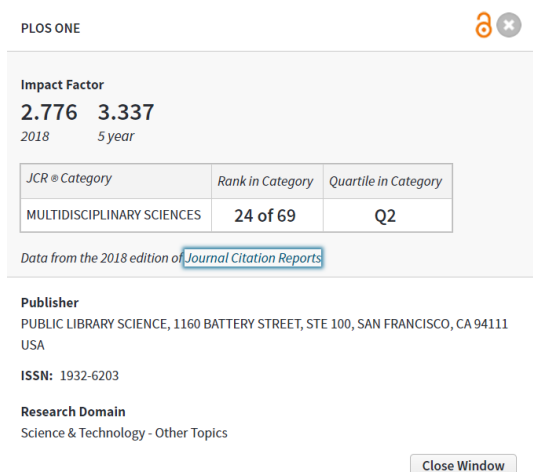


Figure 5.E

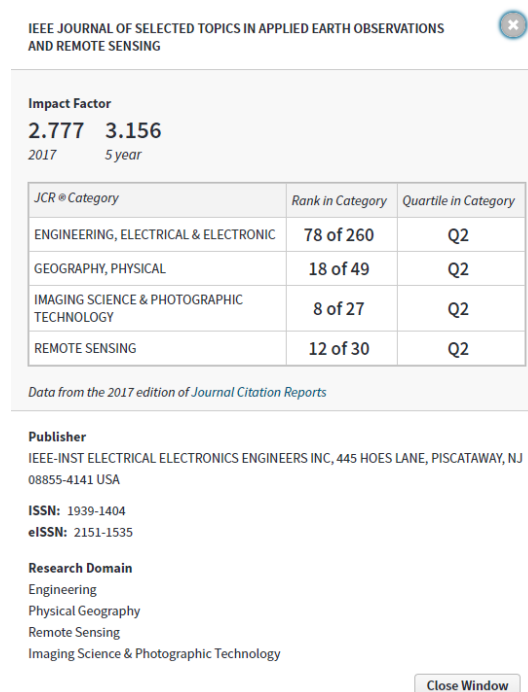


Figure 5.F

Figures 5.A – 5.F. Panorama des journaux à haut impact (Q1 & Q2) où les auteurs ont publié leurs travaux citant l'article

3. Citations de la publication dans Scopus

La publication est citée par onze (11) travaux référencés dans les bases de Scopus. Nous avons utilisé l'application « Harzing's Publish or Perish, version 6.34 » créée par Anne-Wil Harzing, Professeure en Management International à Middlesex University (UK). Cette application permet d'interroger plusieurs bases de données bibliographiques dont Scopus. Néanmoins, la consolidation manuelle a montré qu'au moins 18 travaux référencés dans Scopus, l'ont cité.

Source	Papers	Cites	Cites/year	h	g	h-index	h-index	Quality date	Cache date	Last result
Scopus	11	34	8.50	4	5	4	1.00	0	24/09/2018	24/09/2018
Google Scholar citing references	37	102	25.50	6	9	3	0.75	0	23/09/2018	23/09/2018
Crossref	5	21	6.81	3	4	2	0.68	0	23/09/2018	23/09/2018
Scopus	2	0	0.00	0	0	0	0.00	0	23/09/2018	23/09/2018
Google Scholar	17	607	75.88	9	17	6	0.75	3	23/09/2018	23/09/2018
Google Scholar	22	57	6.37	3	7	2	0.61	0	23/09/2018	23/09/2018
Google Scholar Profile	21	70	5.00	4	8	1	0.21	0	23/09/2018	23/09/2018

Figure 6. Interface de l'application « Harzing's Publish or perish » - Interrogation de la base « Scopus »

Ces résultats datent de **24/09/2018** et le nombre de citations a certainement augmenté. Malheureusement, la nouvelle version 7.17 du logiciel HPP, utilise une API de Scopus qui limite la recherche uniquement aux publications référencées sur les bases Scopus, ce qui n'est pas le cas de la nôtre. En effet, HPP permettait dans sa version antérieure (6.xx), une recherche par « auteur », « affiliations », « publication/journal », par inclusion ou exclusion de « mots clés » et par « phrase exacte ». C'est cette dernière qui nous a permis d'effectuer notre recherche sur le titre exacte de la publication citée « *How to use Big Data technologies to optimize operations in Upstream Petroleum Industry* ».

Figure 7. La requête « phrase exacte » introduite dans « Harzing's Publish or perish » pour interroger la base Scopus

Les résultats de cette requête montrent (figure 8), que notre publication a été citée par onze (11) publications référencées dans Scopus, dont :

- 3 publications dans des journaux de premier ordre Q1 ou Q2 dans leurs domaines respectifs :
 1. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (Q1 sur Scopus / Q2 sur JCR)
 2. Archives of Computational Methods in Engineering (Q1 sur Scopus & JCR)
 3. Industrial and Engineering Chemistry Research (Q1 sur Scopus & JCR)
- 7 papiers de conférences internationales reconnues :
 1. Offshore Technology Conference – Asia 2018, OTC-A 2018
 2. IFIP Advances in Information and Communication Technology 2017
 3. Advances in Database Technology – EDBT 2016
 4. ACM SIGMOD International Conference on Management of Data 2016
 5. IEEE International Conference on Application of Information and Communication Technologies, AICT 2014
 6. IEEE International Conference on Information and Automation, ICIA 2014

	Cites	Per year	Rank	Authors	Title	Year
Publications years:	2014-2018					
Citation years:	4 (2014-2018)					
Papers:	11					
Citations:	34	h 10	5.00	1 D. Agrawal	Road to freedom in big data analytics	2016
Cites/year:	8.50	h 9	4.50	2 D. Agrawal	Rheem: Enabling multi-platform task execution	2016
Cites/paper:	3.09	h 7	1.75	3 R. Alguliyev	Big Data: Big promises for information security	2014
Cites/author:	34.00	h 6	1.50	4 L. Zhang	A framework to specify big data driven complex cyber physical control systems	2014
Papers/author:	11.00	h 1	1.00	5 A. AlInouss	Integrated Data (i-Data), Mining and Utilization Approach for Effective Flare Management Strategies	2017
Authors/paper:	1.00	h 1	1.00	6 C. Lee	Streamlining Digital Modeling and Building Information Modelling (BIM) Uses for the Oil and Gas Projects	2018
h-index:	4	h 0	0.00	7 Y. Rizk	Toward real-time seismic feature analysis for bright spot detection: A distributed approach	2018
g-index:	5	h 0	0.00	8 A. Gedzur	Digitization in the oil and gas industry: Challenges and opportunities for supply chain partners	2017
hi_norm:	4	h 0	0.00	9 O. Bello	Drilling systems design and operational management: Leveraging the value of advanced data-driven analytics	2018
hi_annual:	1.00	h 0	0.00	10 A. Leeri	Real-time warehouse architecture proposal for oil and gas industry	2018
*Count:	0	h 0	0.00	11 P. Joshi	Big data analytics for micro-seismic monitoring	2018

Figure 8. Les résultats de la requête « phrase exacte » dans la base Scopus sur « Harzing's Publish or perish » (M-à-J du 24/09/2018)

4. Citations de la publication sur ResearchGate

La publication est citée par quarante-quatre (44) travaux référencés dans ResearchGate.

Article Full-text available

How to use Big Data technologies to optimize operations in Upstream Petroleum Industry

December 2014
 DOI: [10.5585/iji.v1i1.4](https://doi.org/10.5585/iji.v1i1.4)
 Source: [arXiv](#)
 License: [CC BY 4.0](#)
 Project: [How to use Big Data technologies to optimize operations in Upstream Petroleum Industry](#)

Abdelkader BAAZIZ · Luc Quoniam

Research Interest ⓘ 33.5

Citations 🧑🏫 🧑🏫 🧑🏫 44

Recommendations 0 new 0

Reads ⓘ 17 new 1,415

[See details](#)

Figure 9. Aperçu des informations concernant notre publication sur ResearchGate (M-à-J du 18/01/2020)

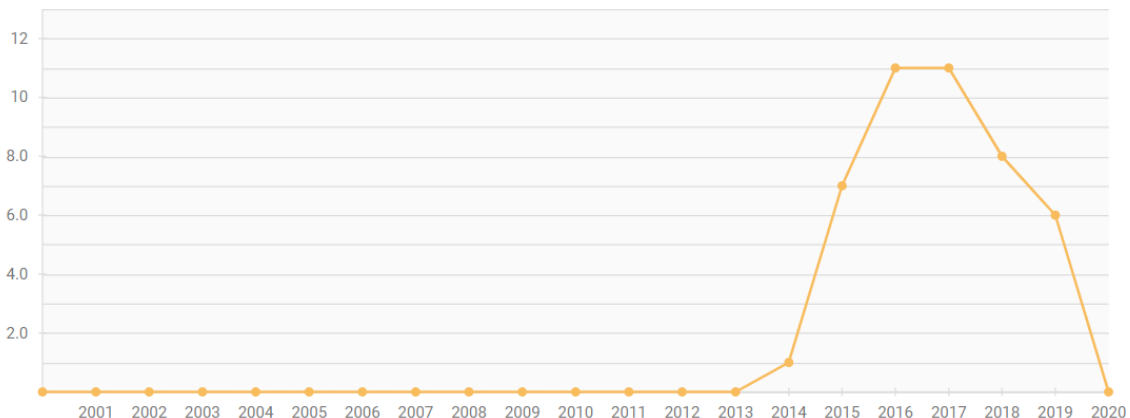


Figure 10. Evolution des citations de la publication sur ResearchGate (M-à-J du 18/01/2020)

5. Citations de la publication dans Google Scholar

La publication est citée par soixante-sept (67) travaux référencés sur Google Scholar.

Abdelkader Baaziz

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 Intelligence Economique Economie Numérique Développement Durable Innovation
 Big Data & Machine Learning

☐ SUMI

Citée par TOUT AFFICHER

	Toutes	Depuis 2015
Citations	117	93
indice h	4	3
indice i10	2	2

TITRE	CITÉE PAR	ANNÉE
How to use Big Data technologies to optimize operations in Upstream Petroleum Industry A Baaziz, L Quoniam International Journal of Innovation 1 (1), 19-25	67	2013
L'information au service du management des risques opérationnels dans les environnements incertains : Cas de la détection précoce des venues durant les forages pétroliers et ... A Baaziz, L Quoniam International Journal of Innovation and Applied Studies 4 (1), 52-67	15*	2013

Année	Citations
2013	0
2014	11
2015	17
2016	22
2017	17
2018	16
2019	17
2020	0

Figure 11. La page Google Scholar de l'auteur « Abdelkader Baaziz » (M-à-J du 18/01/2020)

How to use Big Data technologies to optimize operations in Upstream Petroleum Industry [PDF] à partir de arxiv.org

Auteurs: Abdelkader Baaziz, Luc Quoniam

Date de publication: 2013
Revue: International Journal of Innovation
Volume: 1
Numéro: 1
Pages: 19-25
Éditeur: Nove de Julho University, São Paulo, Brazil - ISSN: 2318-9975 - doi: http://dx.doi.org/10.5585/iji.v1i1.4

Description: "Big Data is the oil of the new economy" is the most famous citation during the three last years. It has even been adopted by the World Economic Forum in 2011. In fact, Big Data is like crude! It's valuable, but if unrefined it cannot be used. It must be broken down, analyzed for it to have value. But what about Big Data generated by the Petroleum Industry and particularly its upstream segment?

Upstream is no stranger to Big Data. Understanding and leveraging data in the upstream segment enables firms to remain competitive throughout planning, exploration, delineation, and field development. Oil & Gas Companies conduct advanced geophysics modeling and simulation to support operations where 2D, 3D & 4D Seismic generate significant data during exploration phases. They closely monitor the performance of their operational assets. To do this, they use thousands of sensors in subsurface wells and surface facilities to provide continuous and real-time monitoring of assets and environmental conditions. Unfortunately, this information comes in various and increasingly complex forms, making it a challenge to collect, interpret, and leverage the disparate data.

Nombre total de citations: Cité 67 fois

Année	Nombre de citations
2014	~2
2015	~5
2016	~10
2017	~8
2018	~12
2019	~10
2020	~2

Figure 12. Fiche récapitulative précisant le nombre de citations et les statistiques des 5 dernières années sur Google Scholar (M-à-J du 18/01/2020)

Google Scholar

Articles Environ 67 résultats (0,04 s)

Date indifférente
Depuis 2020
Depuis 2019
Depuis 2016
Période spécifique ...

Trier par pertinence
Trier par date

Toutes les langues
Rechercher les pages en Français

Inclure les citations

[PDF] Road to Freedom in Big Data Analytics. [PDF] qcri.org
D.Agrawal, S.Chawla, AK.Elmagarmid, Z.Kaoudi. - EDBT, 2016 - da.qcrl.org
The world is fast moving towards a data-driven society where data is the most valuable asset. Organizations need to perform very diverse analytic tasks using various data processing platforms. In doing so, they face many challenges, chiefly, platform dependence ...
★ 97 Cité 22 fois Autres articles Les 3 versions

Rheem: Enabling multi-platform task execution [PDF] rpi.edu
D.Agrawal, L.Ba, L.Berti-Equille, S.Chawla. - Proceedings of the ..., 2016 - dl.acm.org
Many emerging applications, from domains such as healthcare and oil & gas, require several data processing systems for complex analytics. This demo paper showcases system, a framework that provides multi-platform task execution for such applications. It features a ...
★ 97 Cité 23 fois Autres articles Les 10 versions

Big data: big promises for information security [PDF] academia.edu
R.Algulyev, Y.Imamverdiyev - 2014 IEEE 8th International ..., 2014 - ieeeexplore.ieee.org
Big Data is related to technologies for collecting, processing, analyzing and extracting useful knowledge from very large volumes of structured and unstructured data generated by different sources at high speed. Big Data creates critical information security and privacy ...
★ 97 Cité 32 fois Autres articles Les 7 versions

Big data and the internet of things [PDF] arxiv.org
M.Shah - Big data analysis: New algorithms for a new society, 2016 - Springer
Advances in sensing and computing capabilities are making it possible to embed increasing computing power in small devices. This has enabled the sensing devices not just to passively capture data at very high resolution but also to take sophisticated actions in ...
★ 97 Cité 21 fois Autres articles Les 5 versions

A framework to specify big data driven complex cyber physical control systems
L.Zhang - 2014 IEEE International Conference on Information ..., 2014 - ieeeexplore.ieee.org
Big data technology is a new technology that aims to efficiently obtain value from very big volumes of a wide variety of data, by enabling high velocity capture, process, store, discovery and/or analysis, while ensuring their veracity by an automatic quality control in ...
★ 97 Cité 13 fois Autres articles Les 3 versions

[PDF] The obstacles in Big data process [PDF] researchgate.net

Figure 13. Un aperçu des résultats lorsqu'un clique est effectué sur le lien « nombre de citations » (M-à-J du 18/01/2020)

6. Récapitulatif des citations académiques

Le nombre total des citations de notre publication au 18/01/2020 est de 87 citations en tenant compte de l'ensemble des citations indexées par Google Scholar ainsi que les citations non énumérées Google Scholar mais se trouvant dans les bases WoS (au nombre de 10). Nous avons supprimé les citations en double (par exemple, lorsqu'il s'agit d'une version originale et sa traduction).

La rebrique « Autres Académiques » regroupe les publications académiques qui ont cité notre article mais qui ne sont pas indexées dans des bases. **Aucune « autocitation » n'est comptabilisée dans le décompte des citations. Il s'agit bien de citations de tiers auteurs.**

	Google Scholar	WoS	Scopus	ResearchGate	Autres Académ.	Autres Prof.
Nombre de Citations	65	25	>11 (18 ?)	44	04	06
Citations exclusives	-	11		07	04	06
Total des Citations	87 = 65 + 11 + 07 + 04 (Voir listing complet en Annexe)					06

Tableau 3. Récapitulatif des Citations sur Google Scholar, WoS, Scopus & ResearchGate (M-à-J du 18/01/2020)

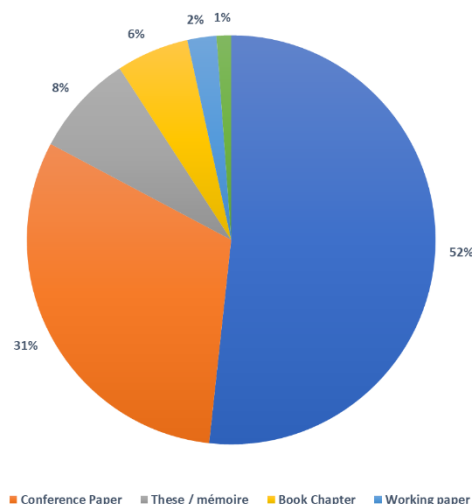


Figure 14. Répartition par types de publications citant notre publication (M-à-J du 18/01/2020)

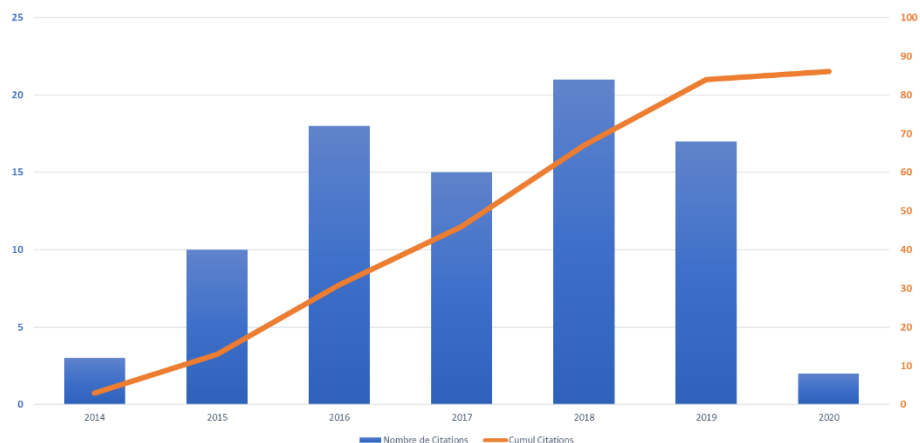


Figure 15. Evolution des citations entre 2014 et 2019

La majorité des publications sont parues dans des journaux académiques « peer review » ou des papiers de conférences internationales à proceedings édités par des célèbres éditeurs tels que Springer, IEEE Xplore, ACM Digital Library ou encore, OnePetro.

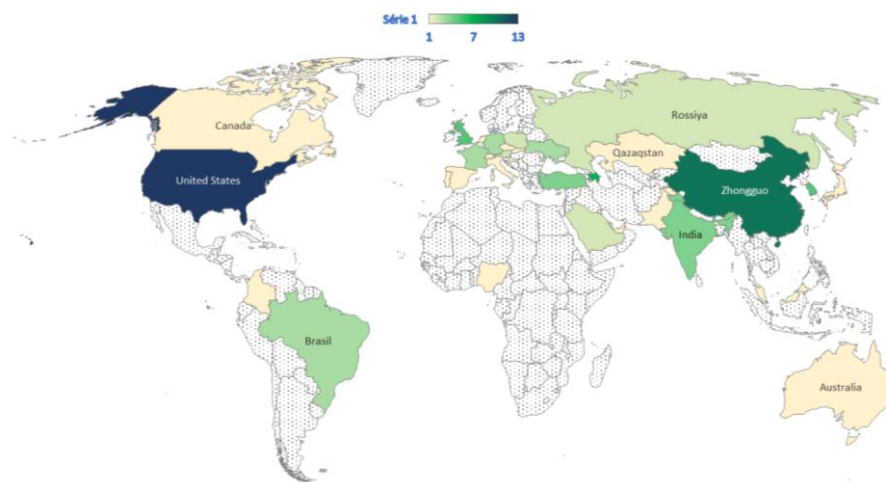


Figure 15. Répartition par Pays des publications citant notre publication (M-à-J du 18/01/2020)

Pour reconstituer la cartographie par pays des publications citant notre publication, nous avons considéré par souci de simplification :

- Le pays de localisation du journal dans le cas d’une publication académique,
- Le pays du lieu où s’est déroulée la conférence dans le cas des « conference papers »,
- Le pays de domiciliation de l’éditeur dans le cas des « book chapters »,
- Le pays où se situe l’institution de recherche à laquelle appartient l’auteur principal dans le cas des « working papers » et des « mémoires & thèses ».

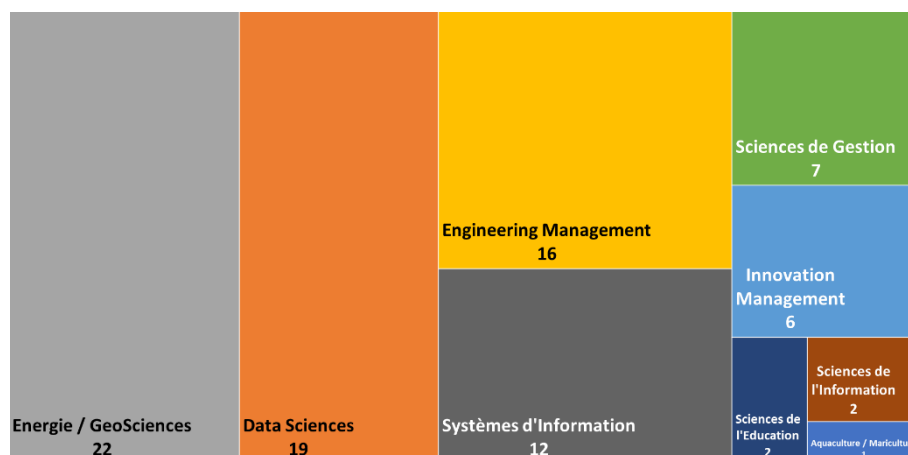


Figure 16. Répartition par champs disciplinaires des publications citant notre publication (M-à-J du 18/01/2020)

Cette représentation relativement exhaustive (figure 16) des champs disciplinaires des auteurs citant notre publication, confirme les résultats de l’échantillon bibliométrique des citations trouvées dans les bases du Web of Science. En effet, elle illustre parfaitement sa portée pluridisciplinaire.

7. Citations professionnelles de la publication

Deloitte, le cabinet conseil de renommée internationale a cité deux fois notre publication : “How to use Big Data technologies to optimize operations in Upstream Petroleum Industry”.

La première citation dans Deloitte Insights (Review), un publication intitulée : “Connected barrels: Transforming oil and gas strategies with the Internet of Things. The Internet of things in the oil and gas industry” ⁽⁴⁾.

La seconde citation intervient pour désigner la publication (avec Berg Insights & Gartner) comme une des trois contributions de référence de l’analyse transformative ⁽⁵⁾ conduisant à un avantage axé sur la perspicacité.

Egypt Oil & Gas, site d'information égyptien spécialisé dans les technologies appliquées au pétrole et au gaz, publie en date du 7 mai 2017, une analyse de Mariana Somensi (Editrice en chef de Egypt Oil & Gas) intitulée “RESERVOIR RECOVERY INFRASTRUCTURE: A Key Investment for Output Boom” où il cite notre publication pour illustrer l’apport des Big Data ⁽⁶⁾ dans les opérations de production et d’exploitation tels que la prédiction des performances futures en fonction des résultats historiques ou identifier des zones de production inférieures à la normale pour transférer leurs actifs vers des zones plus productives et améliorer significativement les taux de récupération du pétrole.

“Society of Petroleum Engineers (SPE) – Italian Section” diffuse régulièrement un bulletin technique trimestriel dont le numéro 1/2017 qui a publié une synthèse de Maria Giulia De Donno (Ingénieure pétrole chez ENI), intitulée “Connected Barrels : IoT opportunities for the oil and gas industry” où elle cite notre publication pour montrer les apports tangibles des Big Data et des objets connectés à l’industrie pétrolière ⁽⁷⁾.

ABB, entreprise helvético-suédoise et acteur majeur des technologies de l’énergie et de l’automatisation ⁽⁸⁾, a publié un livre blanc intitulé “Digitalizing onshore wellheads, pipelines and terminals” ⁽⁹⁾ dont l’objectif est de partager avec les opérateurs onshore des réflexions et conseils afin d’orienter leurs efforts de numérisation du secteur en se basant sur ses propres expériences. Ce livre blanc reprend certaines réflexions que nous avons émises dans notre publication, afin d’optimiser les opérations, améliorer la prise de décision, réduire les temps non-productifs et réduire les risques pour les actifs et le personnel.

Global Energy Monitor est la publication officielle de Energy Governance & Security (EGS) qui a la charge de mener des études stratégiques de la Corée du Sud en matière de pénurie d’eau, pénuries d’énergie, pénuries alimentaires, de crise démographique, de problèmes environnementaux, de sécurité énergétique, de croissance verte et de durabilité environnementale. Elle est aussi, en charge d’élaborer une stratégie énergétique nationale de la Corée du Sud.

⁴ Slaughter, A.; Bean, G. et Mittal, A. (2015). “Connected barrels: Transforming oil and gas strategies with the Internet of Things. The Internet of things in the oil and gas industry”. Deloitte Insights (Review). Lien @ <https://www2.deloitte.com/insights/us/en/focus/internet-of-things/iot-in-oil-and-gas-industry.html> [Consulté le 20/01/2020]

⁵ Mittal, N. (May 5, 2017). “Transformative analytics: Three steps toward an insight-driven advantage”. Deloitte Analytics. Lien @ <https://www2.deloitte.com/us/en/pages/deloitte-analytics/articles/transformative-analytics.html> [Consulté le 20/01/2020]

⁶ Somensi, M. (May 5, 2017). “RESERVOIR RECOVERY INFRASTRUCTURE: A Key Investment for Output Boom”. Egypt Oil & Gas. Lien @ <https://egyptoil-gas.com/features/reservoir-recovery-infrastructure-a-key-investment-for-output-boom/> [Consulté le 20/01/2020]

⁷ De Donno, M. G. (2017). “Connected Barrels: IoT opportunities for the oil and gas industry”. SPE – Italian Section – Technical Bulletin 1/2017 (Mars 2017). Lien @ https://issuu.com/mychicjungle/docs/web_n4 [Consulté le 20/01/2020]

⁸ ABB sur Wikipédia @ [https://fr.wikipedia.org/wiki/ABB_\(entreprise\)](https://fr.wikipedia.org/wiki/ABB_(entreprise)) [Consulté le 20/01/2020]

⁹ ABB (2019). “Digitalizing onshore wellheads, pipelines and terminals”. Lien @ https://www.opuskinetic.com/wp-content/uploads/2019/06/ABB_Digitalizing-onshore-wellheads_pipelines_and_terminals.pdf [Consulté le 20/01/2020]

Elle publie dans son numéro de Janvier 2016, une étude intitulée : 초저유가시기의 생존전략, 디지털오일필드 (Stratégie de survie dans le cas des chutes extrêmes des prix du pétrole : Les gisements pétroliers à l'ère du numérique). Cette publication rédigée par Park Hee-won (PDG, Energy Holdings Group) ¹⁰, cite l'article "How to use big data technologies to optimize operations in upstream petroleum industry" en reprenant l'essentiel des concepts ainsi que les recommandations de mise en œuvre.



8. Récapitulatif global des citations académiques et professionnelles

Les citations académiques et professionnelles de notre publication, recensées à la date du 18/01/2020, sont au nombre de 93 citations. La figure 17 montre la répartition de ces citations. Le total des citations tient compte des redondances de présence dans diverses sources en les supprimant.

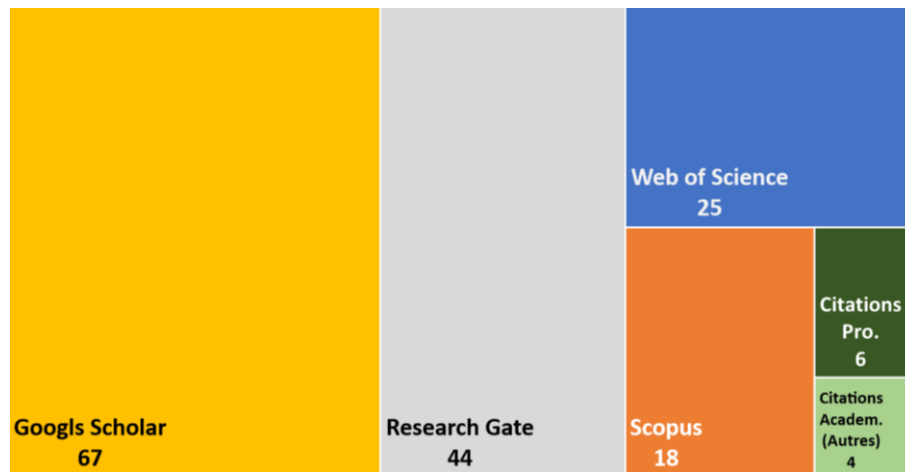


Figure 17. Récapitulatif général des diverses citations notre publication (M-à-J du 18/01/2020)

9. Conclusion

Bien que publiée dans une revue relativement récente (référéncée dans WoS comme source émergente), notre publication a eu un impact fort auprès des chercheurs de divers champs disciplinaires tant en sciences humaines qu'en sciences de l'ingénieur. Ceci souligne sa portée pluridisciplinaire dont l'objectif principal est de jouer un rôle de médiation scientifique et technique auprès des chercheurs et professionnels appartenant à un spectre pluridisciplinaire le plus large possible. Un objectif que nous estimons atteint au vu des résultats de cette modeste étude bibliométrique.

¹⁰ Park Hee-won (2016). 초저유가시기의 생존전략, 디지털오일필드. Global Energy Monitor (Janvier 2016). Lien @ <http://www.egskorea.org/admin/bbs/download.php?code=egs01&idx=5574&no=2> [Consulté le 20/01/2020]

Résumé en Français

Résumé en français de la publication :

How to use Big Data technologies to optimize operations in Upstream Petroleum Industry

Comment utiliser les technologies des Big Data pour optimiser les opérations dans l'activité Amont de l'industrie pétrolière

1. Introduction

L'industrie pétrolière et gazière est un environnement extrêmement concurrentiel et hautement réglementé. Dans cet environnement incertain caractérisé par l'éternelle nécessité de renouveler les réserves de ressources naturelles tout en tenant compte de la fluctuation de la demande et des prix, les compagnies pétrolières et gazières doivent accroître leur production, optimiser les coûts et réduire l'impact des risques environnementaux.

Le secteur amont pétrolier est complexe et ses activités s'appuient essentiellement, sur la collecte et l'analyse des données en temps réel, dont les volumes sont en croissance exponentielle. Les compagnies de l'amont travaillent simultanément avec des données structurées et non structurées. Ils doivent collecter et gérer de plus en plus de données, les stocker, les analyser afin d'obtenir des informations utiles enfouillées dans la masse de données. Dans ces conditions, les outils d'analyse traditionnels sont incapables de les traiter d'où la nécessité d'infrastructures suffisamment dimensionnées (Mainframes, Cloud, etc.) et des outils appropriés (bases de données No-SQL, Big Data Analytics, etc.), les compagnies pétrolières et gazières pourraient tirer une valeur certaine et mesurable de ces données.

2. Définition de Big Data

La première définition du Big Data a été proposée par Meta Group (qui fait désormais partie de Gartner) en décrivant ses trois caractéristiques appelées « 3V » : Volume, Velocity et Variety. En insistant sur les aspects qualitatifs des données, IBM proposa un quatrième V dit Veracity. Cependant, Oracle soulignant la valeur ajoutée certaine de ces données, proposa un autre V dit Value.

La définition la plus populaire des Big Data, s'appuient sur ses six caractéristiques appelées « 6V » : Volume, Vitesse, Variété, Variabilité, Véricité et Valeur.

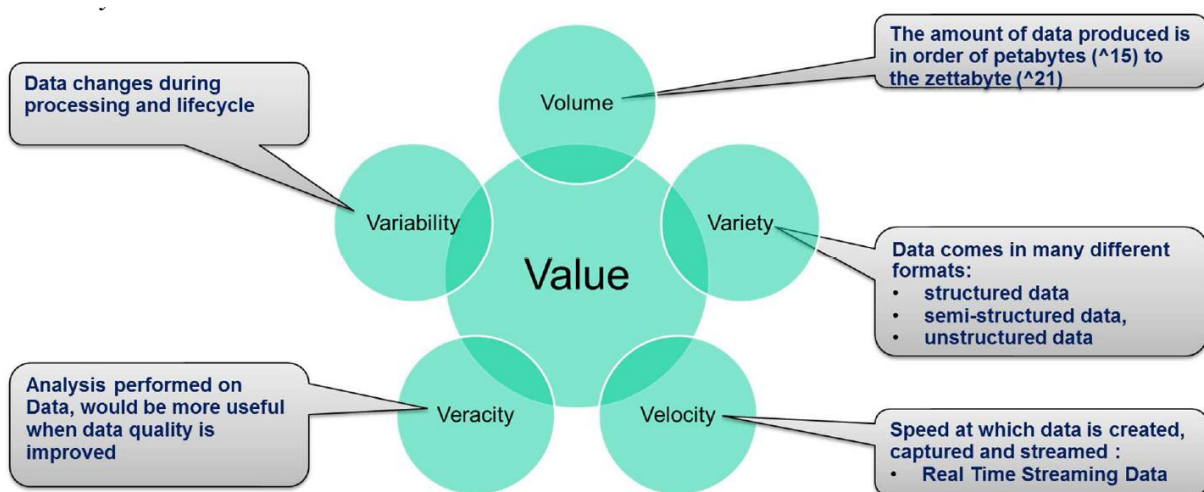


Figure 1. Les 6V du Big Data

Les technologies Big Data décrivent une nouvelle génération de technologies et d'architectures, conçues pour extraire de la valeur à partir de très gros volumes d'une grande variété de données, à travers un processus permettant la collecte, le stockage, le traitement et l'analyse à grande vitesse (en différé ou en temps réel) des données ainsi que la découverte des connaissances tout en assurant leur véracité par un contrôle de qualité systématique et automatique.

Ces technologies reposent essentiellement sur le projet Apache™ Hadoop®, un projet open source de traitement distribués fiable et évolutif.

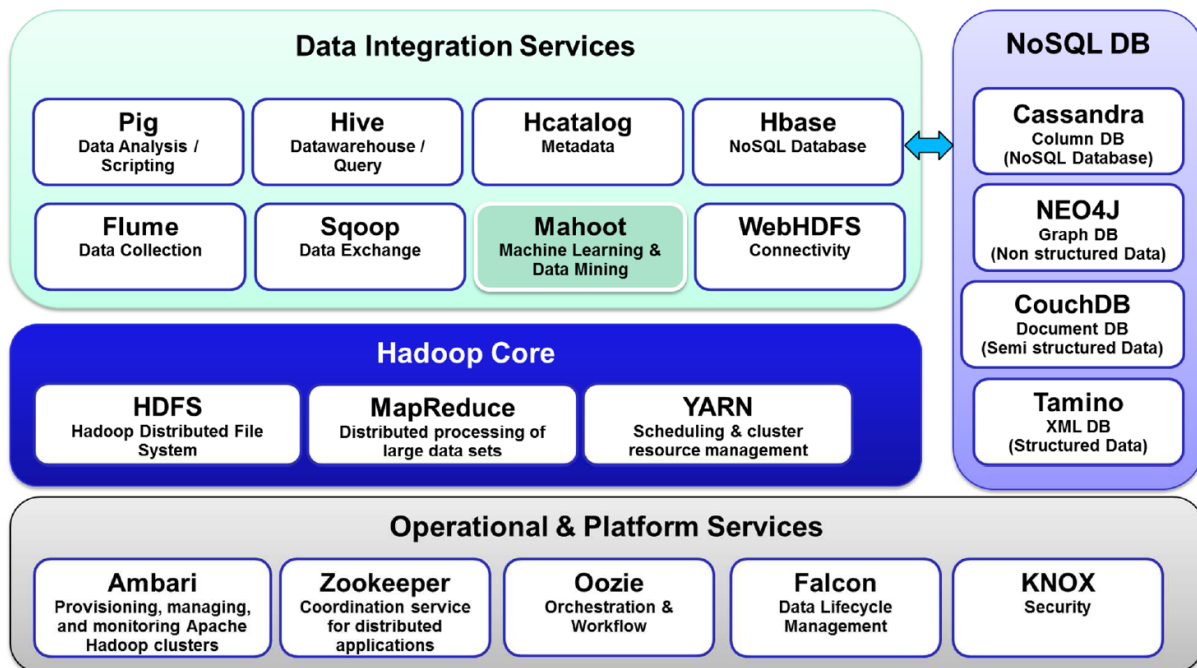


Figure 2. Technologies Big Data basées sur l'écosystème Hadoop (Hadoop est un projet Open source)

3. Big Data dans le secteur amont du pétrole et du gaz

Le secteur de l'amont pétrolier n'est pas étranger au Big Data et à l'Internet des objets (IoT). Les opérateurs de ce secteur utilisent régulièrement, des milliers de capteurs installés dans des puits en subsurface et des installations de surface afin de fournir une surveillance des actifs et des données qu'ils génèrent en continue et en temps réel.

Les volumes de données proviennent de capteurs et de divers appareils de mesure. Les données « structurées » sont gérées avec des applications spécifiques utilisées pour manager la planification de l'exploration, la modélisation des réservoirs, la production et d'autres activités de l'amont. Mais une grande partie de ces données sont « non structurées » ou « semi-structurées » telles que les fichiers de journalisation (logs) et d'imagerie qui doivent être manipulés avec des outils appropriés pour le Big Data.

Pour prendre en charge la prise de décision opérationnelle en temps réel, les compagnies pétrolières et gazières ont besoin d'outils intégrant diverses sources de données dans un ensemble unifié. Elles doivent être capables de traiter les Big Data afin de visualiser (la visualisation est appelée le 7^{ème} V), les relations qui apparaîtraient lorsque toutes ces sources sont traitées dans leur ensemble (Matching). Mais pour libérer cette valeur, les compagnies pétrolières et gazières doivent avoir accès aux technologies, aux outils et aux expertises appropriés.

Comme les Big Data génériques, les données amont sont également caractérisées par le 6V :





	Exploration 	Reservoir Engineering & Development 	Drilling and Completion 	Production 
Volume	Seismic acquisition SEGD	Facilities Reservoir Engineering	Sensors : Flow Pressure ROP	SCADA Sensors : Flow Pressure
Variety	Structured data : • SEGD • Pre-stack • Post-stack Semi-structured : • Implantation Report ...	Structured data : • WITSML (XML) • PRODML • RESML Unstructured data : • Log Curves / Drilling & Test / Lithology / Cores ...	Structured : • WITSML Semi-structured : • Final Well Report, • Daily Drilling Report Unstructured : • Drilling Log / Gas Log .. etc.	Structured Production data : • PRODML • RESML Semi-structured : • Crude Analysis Report
Velocity	Real Time Data Acquisition : Wide azimuth data acquisition		Real Time Data Acquisition : Mud Logging / LWD / MWD	Real Time Data Acquisition : SCADA Sensors
Veracity	Seismic processing	Reservoir Modeling	Sensor calibration	Sensor calibration
Variability	Seismic Interpretation Geology Interpretation	Reservoir Simulation Combination of seismic, drilling and production data	Data Interpretation & Optimisation	Data Interpretation
Value	Navigation, Visualization & Discovery Run integrated asset models	Improve Drilling Program Drive innovation with unconventional resources (shale gas, tight oil)	Reduce costs Reduce Non Productive Time (NPT) Reduce risks Improve HSE performances	Increase speed to first oil Enhancing production

Figure 3. Big Data dans l'Amont pétrolier

Les compagnies pétrolières et gazières devraient tirer parti de leurs centres de recherche et développement (R&D) et/ou collaborer étroitement avec des centres indépendants existants pour explorer le potentiel des Big Data afin de résoudre les problèmes et difficultés techniques rencontrés au quotidien lors des opérations et capitaliser les connaissances afin d'améliorer leurs performances. Elles doivent dans ce cas prendre en compte les exigences d'un environnement collaboratif partagé qui prend en charge la totalité du flux de production des groupes de travail.

Pour résoudre ces problèmes, les groupes de travail R & D devraient avoir un œil permanent sur la richesse des données contenues dans les bases de données brevets. Ces bases de données sont des sources ouvertes « Open Big Data ».

L'étape traditionnelle du prétraitement des données (étape de nettoyage des données dans le traitement de l'information conventionnel) devrait être banni lors du traitement des grands volumes de données géophysiques et géologiques (et dans d'autres domaines autre que pétrolier). Souvent, le biais cognitif aidant (notamment le biais de l'illusion de savoir), nous excluons toutes les données qui ne correspondent pas à notre cadre établi de références scientifiques. En conséquence, nous manquons l'occasion de découvrir et de visualiser de nouveaux phénomènes jusque-là, inexpliqués.

Le Big Data contribue de manière significative à réduire les risques et à optimiser les coûts liés aux opérations et à la santé, la sécurité et l'environnement, nous citerons à titre non-exhaustif :

- Prévenir des événements indésirables lors des forages tels que les irrptions du puit,
- Prévoir les opérations de maintenance des appareils de forage en fonction de leur planning de disponibilité/indisponibilité, optimiser les paramètres de forage et prévenir les accidents liés aux éruptions,
- Utiliser les données de la météo pour la planification des effectifs pour éviter des conditions dangereuses aux travailleurs et atténuer les risques environnementaux.

4. Conclusion

Les principales compagnies pétrolières et gazières ont déjà lancé des projets de déploiement de technologies Big Data leurs permettent de suivre de nouvelles opportunités techniques ou commerciales, à réduire leurs coûts et à réorganiser leurs opérations.

En reconnaissant la valeur des actifs de données inexploités dans la prise de décision basée sur des faits, les compagnies pétrolières et gazières établissent de véritables cas d'utilisation des Big Data. Elles peuvent ensuite créer une valeur commerciale améliorée basée sur l'innovation et générer un avantage concurrentiel durable.

Les compagnies pétrolières et gazières doivent procéder à une analyse des écarts en moyens, en connaissances et en compétences, afin de déterminer les principales exigences du personnel spécialisé en matière de technologie et de gestion des données. Cela permet un investissement ciblé dans des technologies matures, éprouvées et capables de faire face à la croissance exponentielle des volumes de données.

Les compagnies pétrolières et gazières doivent créer de nouvelles stratégies qui les aideraient à manipuler ces données et à les utiliser pour assister les experts dans leurs processus métier et les gestionnaires dans leur processus de prise de décision.

**Texte intégral de la Publication
(Version auteur)**

How to use Big Data technologies to optimize operations in Upstream Petroleum Industry

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Abstract

“Big Data is the oil of the new economy” is the most famous citation during the three last years. It has even been adopted by the World Economic Forum in 2011. In fact, Big Data is like crude! It’s valuable, but if unrefined it cannot be used. It must be broken down, analyzed for it to have value.

But what about Big Data generated by the Petroleum Industry and particularly its upstream segment?

Upstream is no stranger to Big Data. Understanding and leveraging data in the upstream segment enables firms to remain competitive throughout planning, exploration, delineation, and field development.

Oil & Gas Companies conduct advanced geophysics modeling and simulation to support operations where 2D, 3D & 4D Seismic generate significant data during exploration phases. They closely monitor the performance of their operational assets. To do this, they use tens of thousands of data-collecting sensors in subsurface wells and surface facilities to provide continuous and real-time monitoring of assets and environmental conditions. Unfortunately, this information comes in various and increasingly complex forms, making it a challenge to collect, interpret, and leverage the disparate data. As an example, Chevron’s internal IT traffic alone exceeds 1.5 terabytes a day.

Big Data technologies integrate common and disparate data sets to deliver the right information at the appropriate time to the correct decision-maker. These capabilities help firms act on large volumes of data, transforming decision-making from reactive to proactive and optimizing all phases of exploration, development and production. Furthermore, Big Data offers multiple opportunities to ensure safer, more responsible operations. Another invaluable effect of that would be shared learning.

The aim of this paper is to explain how to use Big Data technologies to optimize operations. How can Big Data help experts to decision-making leading the desired outcomes?

Keywords

Big Data; Analytics; Upstream Petroleum Industry; Knowledge Management; KM; Business Intelligence; BI; Innovation; Decision-making under Uncertainty

How to use Big Data technologies to optimize operations in Upstream Petroleum Industry

I. Introduction

The Oil & Gas industry is extremely competitive and highly regulated environment. Against this uncertain environment characterized by the eternal necessity to renewal reserves of natural resources, fluctuating demand and price volatility, Oil & Gas companies need to increase production, optimize costs and reduce the impact of environmental risks.

Oil & Gas upstream sector is complex, data-driven business with data volumes growing exponentially (Febowitz, 2012). Upstream organizations work simultaneously with both structured and unstructured data. They must capture and manage more data than ever and are struggling to store, analyze and get useful information from these huge volumes of data. Under these conditions, the traditional analysis tools would fail but with the appropriate infrastructure and tools, Oil & Gas companies can get measurable value from these data.

The aim of this paper is to show how Big Data can be used to gain valuable operational insight in the Oil & Gas industry and to assist in decision-making in different activities of its upstream sector.

II. Big Data Definition

The first definition of Big Data was developed by Meta Group (now part of Gartner) by describing their three characteristics called “3V”: Volume, Velocity and Variety. Based on data quality, IBM has added a fourth V called: Veracity. However, Oracle has added a fourth V called: Value, highlighting the added value of Big Data (Baaziz & Quoniam, 2013a).

Big Data is defined by six characteristics called “6V”: Volume, Velocity, Variety, Variability, Veracity and Value.

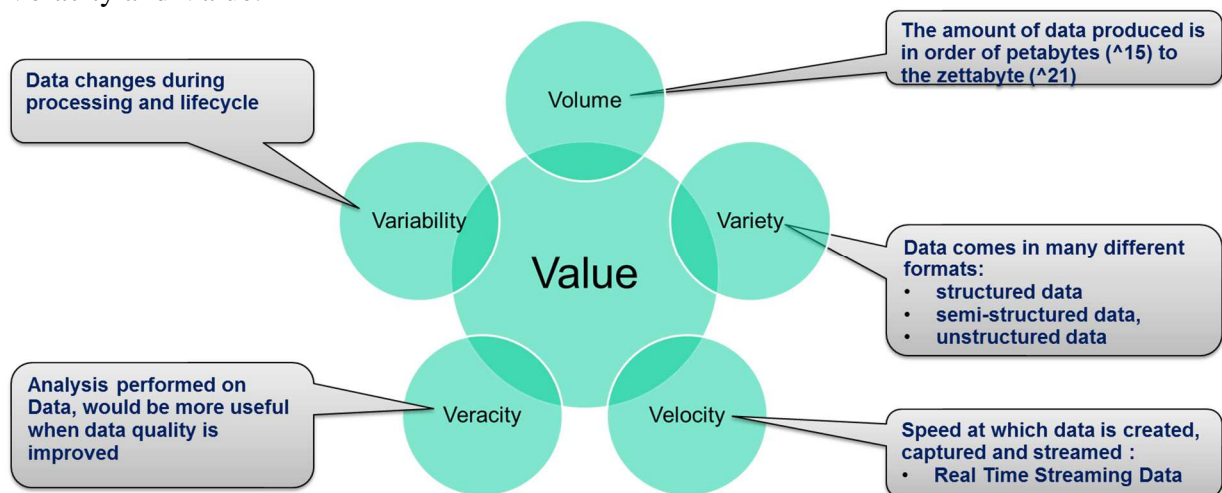


Fig. 1. The “6V” of Big Data

“Big Data technologies describe a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling

high velocity capture, discovery and/or analysis (Febowitz, 2012), while ensuring their veracity by an automatic quality control in order to obtain a big value”.

These technologies are essentially based on the Apache™ Hadoop® project that’s open-source software for reliable, scalable, distributed computing (Hadoop, 2013).

The Apache Hadoop software library is a framework that allows for the distributed processing of large data sets across clusters of computers using simple programming models. It is designed to scale up from single servers to thousands of machines, each offering local computation and storage. Rather than rely on hardware to deliver high-availability, the library itself is designed to detect and handle failures at the application layer, so delivering a highly-available service on top of a cluster of computers, each of which may be prone to failures (Hadoop, 2013).

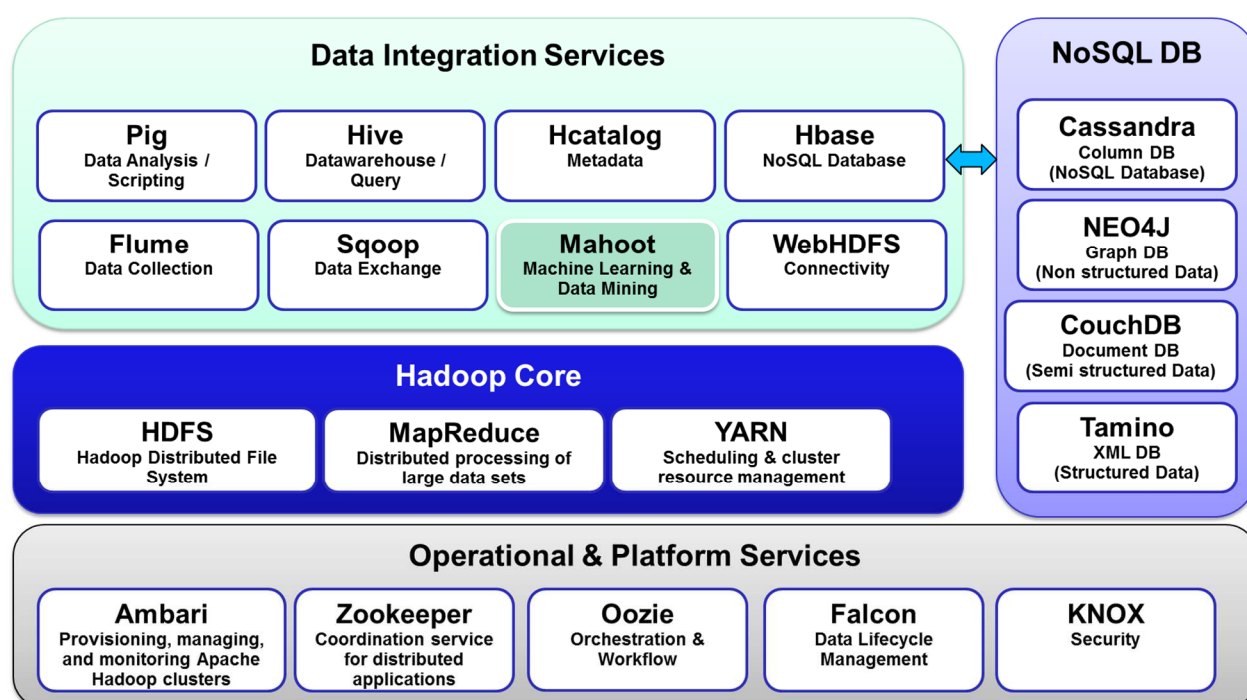


Fig. 2. Big Data technologies are based on Hadoop Ecosystem (Hadoop is an Open source project)

III. Big Data in the Oil & Gas Upstream Sector

1. Overview

Upstream is no stranger to Big Data. Oil & Gas companies use thousands of sensors installed in subsurface wells and surface facilities to provide continuous data-collecting, real-time monitoring of assets and environmental conditions (Brulé, 2013).

The data volume is coming from sensors, spatial and GPS coordinates, weather services, seismic data, and various measuring devices. “Structured” data is handled with specific applications used to manage surveying, processing and imaging, exploration planning, reservoir modeling, production, and other upstream activities. But much of this data is “unstructured” or “semi-structured” such as emails, word processing documents, spreadsheets, images, voice recordings, multimedia, and data market feeds, which means it’s difficult or costly to either store in traditional data warehouses or routinely query and analyze. In this case, appropriate tools for Big Data should be used (Hems & al., 2013).

To support the real-time decision-making, Oil & Gas companies need tools that integrate and synthesize diverse data sources into a unified whole. Being able to process Big Data makes it possible to derive insight from the relationships that will surface when all of these sources are processed as a whole. But to unlock this value, Oil & Gas companies need access to the appropriate technology, tools, and expertise (Baaziz & Quoniam, 2013a).

Like generic Big Data, the Upstream Data is also characterized by the 6V:





	Exploration 	Reservoir Engineering & Development 	Drilling and Completion 	Production 
Volume	Seismic acquisition SEGD	Facilities Reservoir Engineering	Sensors : Flow Pressure ROP	SCADA Sensors : Flow Pressure
Variety	Structured data : • SEG • Pre-stack • Post-stack Semi-structured : • Implantation Report ...	Structured data : • WITSML (XML) • PRODML • RESML Unstructured data : • Log Curves / Drilling & Test / Lithology / Cores ...	Structured : • WITSML Semi-structured : • Final Well Report, • Daily Drilling Report Unstructured : • Drilling Log / Gas Log .. etc.	Structured Production data : • PRODML • RESML Semi-structured : • Crude Analysis Report
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Value	Navigation, Visualization & Discovery Run integrated asset models	Improve Drilling Program Drive innovation with unconventional resources (shale gas, tight oil)	Reduce costs Reduce Non Productive Time (NPT) Reduce risks Improve HSE performances	Increase speed to first oil Enhancing production

Fig. 3. Upstream Big Data

2. Big Data Still in experimental stage in Oil & Gas Industry

Work on the application of Big Data and Analytics in the Oil & Gas industry is in the experimental stage (Febowitz, 2012). Only a handful companies have adopted Big Data in the field (Nicholson, 2013):

- Chevron proof-of-concept using Hadoop (IBM BigInsights) for seismic data processing ;
- Shell piloting Hadoop in Amazon Virtual Private Cloud (Amazon VPC) for seismic sensor data ;
- Cloudera Seismic Hadoop project combining Seismic Unix with Apache Hadoop ;
- PointCross Seismic Data Server and Drilling Data Server using Hadoop and NoSQL ;
- University of Stavanger data acquisition performance study using Hadoop.

Much of the software innovation that's key to the digitization of big oil is happening at oil service contracting companies, such as Halliburton and Schlumberger, and big IT providers including Microsoft, IBM, Oracle and Open Source Projects.

3. Exploration and Development

By combination of Big Data and advanced analytics in Exploration and Development activities, managers and experts can perform strategic and operational decision-making.

The areas where the analytics tools associated with Big Data can benefit Oil & Gas exploration include:

- **Enhancing exploration efforts:** Historical drilling and production data help geologists and geophysicists verify their assumptions in their analysis of a field where environmental regulations restrict new surveys (Febowitz, 2012). Combine enterprise data with real-time production data to deliver new insights to operating teams for enhancing exploration efforts (Hems & al, 2013).
- **Assessing new prospects:** Create *competitive intelligence* using Analytics applied to geospatial data, oil and gas reports and other syndicated feeds in order to bid for new prospects (Hems & al, 2013).
- **Identifying seismic traces:** Using advanced analytics based on Hadoop and distributed Database for storage, quick visualization and comprehensive processing and imaging of seismic data (Seshadri, 2013) to identify potentially productive seismic trace signatures previously (Hems & al., 2013).
- **Build new scientific models:** By using high performance computing and based on combination between “historical data” and “Real Time Data Acquisition”: Petabyte seismic data sets, Mud Logging, MWD, LWD, Testing, Gamma Ray (Nicholson, 2013) & (Seshadri, 2013).

4. Drilling and Completion

Making the drilling platforms and pipeline infrastructure smart to anticipating issues and acting to prevent failures and increase productivity (Seshadri, 2013). In this case, Big Data is used to identify conditions or anomalies that would impact on drilling operations can save human lives and equipments. Real-time information returned from supervisory control and data acquisition systems on well-heads can be used to grasp opportunities that maximize asset performance and optimize production (Hems & al, 2013).

Related areas where analytics can improve drilling and completion operations:

- **Build and assessment of drilling models:** based on all existing well data. These models are incorporated with geologic measurement into drilling processes, such as shale development (Hems & al., 2013). This will refresh models based on incoming sensor data from drill rig and help to optimize drill parameters.
- **Improve Drill Accuracy and Safety:** by early identifying anomalies that would impact drilling and prevent undesired events: kicks, blowout, etc.
- **Drilling optimization:** predictive Analytics help to reduce NPT, by early identifying the negative impacting factors of drilling operations.
- **Cost optimization:** by using scalable compute technologies to determine optimum cost.
- **Real-time decision-making:** must act in real time on drilling data and formation evaluation data and use this data for predictive modeling to facilitate real-time decision-making.
- **Predictive maintenance:** predict drill maintenance/downtime.

5. Production

Big Data is of great interest to production and operation work. Being able to predict future performance based on historical results, or to identify sub-par production zones, can be used to shift assets to more productive areas. Oil recovery rates can be improved, as well, by integrating and analyzing seismic, drilling, and production data to provide self-service business intelligence to reservoir engineers.

- **Enhanced oil recovery:** Enhancing oil recovery from existing wells is a key objective for oil and gas companies. Analytics applied to a variety of Big Data at once – seismic, drilling, and production data – could help reservoir engineers map changes in the reservoir over time and provide decision support to production engineers for making changes in lifting methods. This type of approach could also be used to guide fracking in shale gas plays (Feblowitz, 2012).
- **Performance forecasting:** Forecast production at thousands of wells. Aging wells where the forecast does not meet a predetermined production threshold are flagged for immediate remediation (Feblowitz, 2012).
- **Real-time production optimization:** Real-time SCADA and process control systems combined with analytics tools help Oil & Gas producer to optimize resource allocation and prices by using scalable compute technologies to determine optimum commodity pricing. They also, help to make more real time decisions with fewer engineers (Hollingsworth, 2013).
- **Improve Safety and prevent risks:** by early detecting well problems before they become serious – slugging, WAG gas breakthrough.

6. Equipment maintenance:

Predictive maintenance is not a new concept for the oil and gas industry, although if you ask a maintenance executive, it does not get the attention and budget it deserves. In upstream, if pressure, volume, and temperature can be collected and analyzed together and compared with the past history of equipment failure, advanced analytics can be applied to predict potential failures. Additionally, many upstream operations are in remote locations or on ships, so being able to plan maintenance on critical assets is important, especially if work requires purchase of specialized equipment (Feblowitz, 2012).

Technicians often use data collected from pumps and wells to adjust repair schedules and prevent or anticipate failure. Better predictive maintenance also becomes possible (Hems & al., 2013):

- **Preventing down time:** Understand how maintenance intervals are affected by variables such as pressure, temperature, volume, shock, and vibration to prevent failure and associated downtime.
- **Optimizing field scheduling:** Use this insight to predict equipment failures and enable teams to more effectively schedule equipment maintenance in the field.
- **Improving shop floor maintenance planning:** Integrate well and tool maintenance data with supply chain information to optimize scheduling of shop floor maintenance.

7. Reservoir Engineering

Oil & Gas companies improve understanding of future strategy based on available oil for a better identification of reservoirs and reserves by integrate real-time data into the earth model both on the rig and in the office.

Also, they predict the chances of success of turning reservoir into a production well by:

- **Improving engineering studies:** engage sophisticated subsurface models and conduct detailed engineering studies on wells to identify commercial prospects earlier and with less risk (Febowitz, 2012).
- **Optimizing subsurface understanding:** Use Big Data tools to understand the earth's subsurface better and to deliver more affordable energy, safely and sustainably.
- **Experiences and learned lessons from drilling operations:** such determination of drilling coordinates through oil shale to optimize the number of wellheads needed for efficient extraction of oil, optimization of drilling resources by not over drilling well site, reducing waste of drilling exploration wells, etc.

8. Research & Development

Oil & Gas companies should take advantage of their Research & Development Centers (CRD) or through close collaboration with existing independent centers to explore the potential of Big Data to resolve problems and technical difficulties they encounter in daily operations and capitalize knowledge to improve performance. They must in this case, taking into account the requirements of a shared collaborative environment that supports the flow of total production of the working groups.

To solve problems, R&D workgroups should have permanent eye on the wealth of data contained in the patent databases to be inspired particularly as these databases are considered as Open Big Data.

Patents are a unique and invaluable source for R&D because the information they contain, are generally not published elsewhere. In addition, they have a limited duration after which they can be operated without rights. They can also be fallen (for non-payment of annuities, for example) and may in this case be used freely. Finally, they may only be published in certain countries and thus they are not extended to other, hence the possibility to freely operate in these countries (Baaziz & Quoniam, 2013b).

The automatic patent analysis involves using information contained in a patent by analytics software in order to present outcomes by facilitating up the work of experts to understand developments, actors and subjects appearing in the research (Baaziz & Quoniam, 2013b).

It thus shows the correlations needed to answer common questions (Baaziz & Quoniam, 2013b):

- Importance of the subject and its evolution over time,
- Different technologies and applications involved,
- Who does what? How? (automatic benchmarking of companies),
- What are the trends in research and applications by applicants, inventors, inventors group or country,
- Etc.

Understand the importance of patent information and its proper use at the right time to reduce risks related to operational activities in uncertain environments (Baaziz & Quoniam, 2003b) like developing strategy to address critical design issues or analyzing root causes of design flaw in engineering projects. (Seshadri, 2013).

9. Data Management

Big Data and analytics include infrastructure, data organization and management, analytics and discovery for decision support. Infrastructure includes the use of industry-standard servers, networks, storage, and clustering software used for scale-out deployment of Big Data technology. Data organization and management refers to software that processes and prepares all types of data for analysis (Febowitz, 2012).

10. Security

Oil & Gas companies anticipate IT security breaches by using predictive analytics and bolstering security with data from the global protection systems including video monitoring, access control et anti-intrusion.

Also, there is particular interest in deploying complex event processing (CEP) technology to monitor security concerns in the Oil & Gas industry in real time by (Hems & al., 2013):

- Combining data from multiple sources to infer events or patterns that indicate a current or imminent threat.
- Making faster decisions, supported by faster delivery of decision support information, to identify possible threats.
- Predict/prevent cyber-terror acts.

11. Health, Safety & Environment

Big Data contributes significantly to reduce risk and optimize costs related to operations and Health, Safety and Environment (Baaziz & Quoniam, 2013b):

- Prevent undesired events while drilling like kicks,
- Predict drill maintenance/downtime, optimize drill parameters and prevent blowout accidents,
- Using weather or workforce scheduling data to avoid creating dangerous conditions for workers and mitigating environmental risks.

IV. Conclusion

Leading Oil & Gas companies are already began projects to deploying Big Data technologies that can help them track new business opportunities, reduce costs and reorganize operations.

By recognizing the value of the unexploited data assets in supporting fact-based decision-making, Oil & Gas companies establish real cases of Big Data uses. Then they can create enhanced business value based on innovation and able to lead towards a sustainable competitive advantage.

Oil & Gas companies must first proceed to a gap analysis to determine the major requirements of technology and data-management expert staff. This allows a focused investment in mature and proven technologies as well as those who will face the exponential growth of data volumes.

Oil & Gas companies must create new strategies that will help them manipulate these data and use them to support experts in their business process and managers in their decision-making process.

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Annexes

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HOW TO USE BIG DATA TECHNOLOGIES TO OPTIMIZE OPERATIONS IN UPSTREAM PETROLEUM INDUSTRY

By: Baaziz, A (Baaziz, Abdelkader)^[1]; Quoniam, L (Quoniam, Luc)^[1]

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Abstract

"Big Data is the oil of the new economy" is the most famous citation during the three last years. It has even been adopted by the World Economic Forum in 2011. In fact, Big Data is like crude! It's valuable, but if unrefined it cannot be used. It must be broken down, analyzed for it to have value.

But what about Big Data generated by the Petroleum Industry and particularly its upstream segment?

Upstream is no stranger to Big Data. Understanding and leveraging data in the upstream segment enables firms to remain competitive throughout planning, exploration, delineation, and field development.

Oil & Gas Companies conduct advanced geophysics modeling and simulation to support operations where 2D, 3D & 4D Seismic generate significant data during exploration phases. They closely monitor the performance of their operational assets. To do this, they use tens of thousands of data-collecting sensors in subsurface wells and surface facilities to provide continuous and real-time monitoring of assets and environmental conditions. Unfortunately, this information comes in various and increasingly complex forms, making it a challenge to collect, interpret, and leverage the disparate data. As an example, Chevron's internal IT traffic alone exceeds 1.5 terabytes a day.

Big Data technologies integrate common and disparate data sets to deliver the right information at the appropriate time to the correct decision-maker. These capabilities help firms act on large volumes of data, transforming decision-making from reactive to proactive and optimizing all phases of exploration, development and production. Furthermore, Big Data offers multiple opportunities to ensure safer, more responsible operations. Another invaluable effect of that would be shared learning.

The aim of this paper is to explain how to use Big Data technologies to optimize operations. How can Big Data help experts to decision-making leading the desired outcomes?

Keywords

Author Keywords: Big Data; Analytics; Upstream Petroleum Industry; Knowledge Management; KM; Business Intelligence; BI; Innovation; Decision-making under Uncertainty

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