



USE OF MODERN DATA VISUALISATION TO INNOVATE CLIENT ENGAGEMENT AND IMPROVE DATA ANALYTICS

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1 Introduction

Within the energy sector, specialist consultancy services are a vital part of the supply chain. They provide skill sets that are commonly important but niche, and which do not fit easily within larger, more generalised teams within larger companies (e.g., Shell or BP in this sector). PetroStrat is one of these specialist consultancies, providing a range of scientific analytical products that are the foundation for both hydrocarbon exploration and underground carbon storage.

However, these consultancies exist within a competitive marketplace and, along with providing competitive price points, must also provide new and 'innovative' products/services to retain repeat work and increase market share.

This document will discuss a modern innovation from PetroStrat; namely the "USE OF MODERN DATA VISUALISATION TO INNOVATE CLIENT ENGAGEMENT AND IMPROVE DATA ANALYTICS". In summary, this innovation uses open-source programming languages and compiling software to access multiple databases, join multiple data tables together and then serve this data to a series of interactive dashboards that can be accessed through an MS Edge browser (see Figure 1 for an example).



Figure 1: Example dashboard comparing petrophysical, core and petrographic data. Visualisation is built using Flexdashboard library within rmarkdown.(authors own work)

Dashboards were first used in the 1970's and 1980's, providing information on an 'executive' level (Few, 2006). Initially, they were used to visualise financial data, however, present day dashboards are used across multiple industries and multiple disciplines (Dover, 2004). Data visualisation within dashboards is typically dynamic, allowing a user to interact with large datasets through simple tools. It is hoped this type of visualisation and data interrogation will increase internal (staff) and external (client) interaction with PetroStrat data, leading to increased client engagement and, ultimately, placing PetroStrat within its clients' daily workflows. It is hoped this will provide PetroStrat a competitive advantage within the energy sector supply chain.

2 Innovation drivers and barriers

This section will focus on the drivers, barriers and risks to the selected innovation.

2.1 The principle drivers for the innovation

Innovative products/services form in response to a question or need from a specific demographic or market/client base. Within PetroStrat, the following drivers were responsible for the conception and development of this innovative data-driven visualisation:

Shifting requirements/expectations of our clients: Modern desktop computing, in collaboration with a more tech-savvy workforce has resulted in PetroStrat's client base increasingly asking for live-access to data throughout the course of a project. Furthermore, complicated data analytics, including Machine Learning is expected to be performed on this data. Whilst these 'requirements' are relatively new, they represent the new norm and a shift in what PetroStrats' clients expect. This is a major driver and PetroStrat must act accordingly.

Supply-chain market competition: PetroStrat operates in a competitive market and must keep-up with developments made by its competitors. Within digital and data science, these developments move quick, so PetroStrat must be agile. Ultimately, innovation drives competitiveness and creates new market spaces (Herrera, 2016).

Internal pressure to leverage legacy data value: Through 20+ years of operation, coupled with acquisition, PetroStrat has a large legacy dataset. At present, this data is providing very little revenue. However, if it was accessible through this innovative data-driven visualisation, its value would increase and potentially allow a new revenue stream to be built (e.g., an annual subscription model).

Efficiency saving: Currently, most data analysis within PetroStrat is undertaken manually. By using this innovative visualisation, a lot of this work can be variably automated, resulting in increased consistency between staff, as well as faster reporting and associated increased efficiency savings.

2.2 The barriers and risks faced by the company in developing this innovation

2.2.1 Barriers to Innovation

Innovation is not without inherent risks. The concept of innovation requires new ideas to be developed, or new workflows to be built. As such, there is a level of uncertainty that underpins the innovation process; will this new product be a commercial successful? Will we be able to achieve what we set out to achieve? And if we don't, how do we re-coup the personnel/financial costs involved? Are we prepared to fail?

Within PetroStrat, multiple barriers presented themselves in regard to this specific innovation. These can be grouped into the following categories:

Internal skill sets: Development and scalable deployment of this innovation requires application of multiple data science techniques. This includes experience in using python, SQL and/or R programming languages to connect to multiple databases, extracting and transforming these data and serving them to a custom-built visualisation tool.

PetroStrat do not traditionally contain these skillsets. This represents a significant barrier to progression; PetroStrat knows what it wants to build, but it does not have the internal capability to build it. Consequently, these skill sets need to be either sourced externally, or a period of up-skilling of selected staff members will need to take place

Financial constraints: Without a proper specification and a considered development plan, it will not be possible to deploy this type of innovation effectively. As such, in addition to any hiring or up-skilling costs, PetroStrat will have to provide funds and personnel time to allow adequate technology/process specifications to be drawn up. Without this initial capital investment, this innovation will stall.

Management vision and change management: Clear communication of management vision is key to instigate and control change management within an organisation. Without it, internal staff resistance to change is likely to be the largest barrier to any innovation.

Within PetroStrat, this data science driven innovation marked a step-change in how PetroStrat both interrogated and delivered its data and the application of data science on this scale had not been attempted before within the company. Internal resistance from staff resulted in slow up-take.

This was compounded by limited communication from senior management to staff; whilst senior management had a broad vision for what this innovation could produce in terms of an end-product and associated commerciality, they did not communicate it clearly and frequently enough with staff. Consequently, change management within the company was not controlled as well as it could have been.

Increased risk avoidance: Similar in scope to change management, some senior managers appear more wary of potential risk than others, leading to barriers that stall innovation applications. This is not unique to PetroStrat, being common in, for example the banking system (Das *et al.*, 2018) where large sums of money are at play.

2.2.2 Risks to Innovation

Any innovation bears a number of different risks. Within this selected innovation, the main risks were:

Developing a non-commercial product through closed innovation: This is a major risk. If any product/service is developed in a closed way, without major stakeholder involvement, it is quite easy to develop something that 'fits the brief' but is not wanted by the market. If this happens, the end-product/service is unlikely to be commercially successful. Gaining client feedback at multiple 'decision gates' along the course of this innovation is key to mitigating this risk; clients will tell you what they want and tell you if what you've built meets their requirements.

Missing the boat: Vendors within the supply chain move rapidly, particularly when developing a new technology or software application. This rapid speed of development is typically through agile innovation. With limited skills/resource internally, PetroStrat are in danger of coming to market too late with a product that might not meet its customer's requirements.

2.3 The key determinants in the process of committing to develop the innovation

Having understood the risks and barriers associated with this innovation, the determinants outlined below allowed PetroStrat to commit to developing the innovation:

Access to funding: Access to Government funding bodies was key to committing PetroStrat to develop this innovation. Innovate UK (<https://www.ukri.org/what-we-offer/our-main-funds/industrial-strategy-challenge-fund/>) as well as SMART Cymru (<https://businesswales.gov.wales/innovation/smart-innovation>) provide funding that can be put towards feasibility studies as well as Research & Development (R&D). Between 2015 – 2020, the innovation arm of SMART Cymru has invested £150 million across Wales. Without funding such as this, SME's like PetroStrat will struggle to provide enough capital to fund initial feasibility studies/technical specification projects and innovation will be more ad hoc as a result.

Corporation tax relief, based on R&D claims, from HMRC is also another source of funding that PetroStrat utilises to fund R&D projects. This capital is perhaps less accessible during the course of a single innovation/R&D study, compared to that provided by, e.g., SMART Cymru, but it does help encourage continuous R&D within the company.

Internal staff development: As well as providing funds for feasibility and R&D projects, Business Wales also provides funds for internal staff upskilling (<https://businesswales.gov.wales/skillsgateway/flexible-skills-programme>), particularly for increasing digital skills. Access to these dedicated funds allows PetroStrat to develop a large portion of the skills required to both develop and implement this innovation.

Client feedback: Very early on within the planning stage, a simple prototype was built and demonstrated to a client. Their feedback was very positive, even asking what commercial model PetroStrat intended to use so they could purchase the prototype. This positive feedback was another key determinant in committing PetroStrat to further this innovation as it suggested a commercial need for it existed. By gaining this feedback, PetroStrat moved from a closed innovation to a more open innovation.

3 Innovation development and deployment

This section will focus on development and deployment of the selected innovation.

3.1 The processes and technologies which the company used to carry this development forward

This innovation represented a major step-change in PetroStrat's traditional offerings and required new processes to be developed. Firstly, a standardised R&D application procedure was developed internally that allowed anyone in the company to nominate a potential R&D project. This centralised internal R&D applications into one department, providing a more efficient control on spend and resource allocation. This was centralised within the New Venture department where this innovation was initially suggested.

After review, PetroStrat adopted the Technology Readiness Level scheme (TRL: https://www.nasa.gov/directorates/heo/scan/engineering/technology/technology_readiness_level), using the adapted EU version (<https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels>) as shown on Figure 2.



Figure 2: Technology Readiness Level as modified by the EU. Taken from (<https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels>)

Although originally devised by NASA in the 1970's (<https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels>), this nine-part scheme can be applied to innovation development. Using the EU adapted version, this scheme breaks innovation down into three main categories: Research, Development and Deployment, with each category comprising three TRL's (Figure 2).

Within PetroStrat, a set of clear objectives per TRL were defined and a go/no-go decision gate was built between each main category. A TRL level could not be 'complete' until the objectives set for the TRL were achieved. This provided a consistent set of steps that this (or any other innovation) could follow to control its development, with decisions made on its potential commerciality (based on internal/external feedback) at each decision gate.

To manage this process, these TRL objectives were built into a set of specific 'innovation development' MS Dynamics templates, with MS Dynamics acting as a centralised Project Management System (PMS). By adding these objectives into MS Dynamics, it was very easy to control time and spend on each objective and thus provided an efficient platform to oversee the innovation development.

3.2 The extent to which the development relied on resources external to the company and the ways in which the deployment of these resources was managed

For this innovation, PetroStrat relied heavily on external resources. This fell into two categories:

- **External financial resources:** PetroStrat applied to Innovate UK and SMART Cymru to access funding to support an initial feasibility study, supporting TRL's 1 – 3 of Figure 2. Upskilling of selected staff was also defined as a key determinant in this innovation and a funding application to the Flexible Skills Programme (part of SMART Cymru) is in progress. If successful this will allow PetroStrat to build resources internally to help deliver on the aims of this innovation.
- **External Software skills:** This innovation relies heavily on building bespoke software's, which is a skill set PetroStrat does not sufficiently have. To develop and build this innovation, PetroStrat is working with independent software developers to build parts of the digital visualisation tool where internal skills in PetroStrat were not present/not adequate.

These resources are managed in different ways. Any funding awarded to PetroStrat is handled centrally and made available to the team developing the innovation when required.

The need for external software developers was identified early, and external software developers were brought in early within the life-cycle of the project, around TRL 2 (Figure 2). This meant they had input in the design process for this innovation and became a key stakeholder. In doing this they essentially became an additional team member working under the project manager and deployed to individual tasks in a similar way to PetroStrat staff; working to achieve specific objectives within each TRL they had been assigned to.

3.3 How management overview of the innovation of the development was maintained

By using the TRL system, grouped into the Research – Development – Deployment categories (Figure 1), it was easy to communicate progress to the relevant management grade at the right time. Senior

management/directors maintained overview through key decision gates and associated go/no-go meetings (occurring at the end of the TRL 3, TRL6 and TRL8).

Day to day management was done by the project manager, with weekly progress updates provided to the New Venture management team (essentially budget spent vs. predicted completion of agreed tasks along the TRL1 – TRL9 pipeline). In this way, all levels of management had the correct level of oversight of the innovation development at the right time.

4 Conclusions

This section provides an overview of the selected innovation and asks two main questions:

1. Does this innovation process (i.e., the process that guided the development of the selected innovation) represents a best practice approach, and;
2. What is the success of the selected innovation?

4.1 The extent to which you feel this innovation process represents best practice

In this report's opinion, application of the Technology Readiness Level (TRL) process represents a best practice approach to control/steer innovation development. It provides a good mechanism to control innovation development by providing a series of objectives that can be grouped into clear steps/levels, which in turn feed into a series of go/no-go decision gates. It can be replicated between innovation projects and can provide the correct level of oversight to different level of management.

4.2 Provide a critique of the whole innovation process and an evaluation (to the extent one is possible of very recent innovations) of the success of your chosen innovation

4.2.1 Critique of the innovation process

Overall, this report believes the innovation process applied at PetroStrat to be 'good', with both positive and negative elements observed:

Positives:

- The TRL system applied in PetroStrat makes it easy to plan the development of the innovation, with known objectives and decision gates to be reached before an innovation idea can be become a new service or product;
- PetroStrat effectively uses external funding to help cover costs that otherwise might be hard to find in an SME of this size;
- There is a genuine want from senior management to develop new ideas so that PetroStrat remains competitive within the supply chain, with a desire for PetroStrat to lead the conversation in some areas. This leads to a culture where ideas from anyone at any grade are, at least, listened too and quickly evaluated.

Negatives:

- PetroStrat relies too heavily on external funding; Potentially good projects stall at the start line as initial finance to preliminarily scope out an idea is not easily available. This initial capital is needed first, and should be used to scope-out and write larger feasibility grant applications to Innovate UK and SMART Cymru. These grants then provide the majority of funding through TRL1 – TRL3, but require some internal capital to start the whole process off;
- Senior management communication is sometimes limited; Innovation projects that have been green lighted are not open communicated about from senior management to the company. This means any strategy that pertains to that innovation is not openly communicated at the right time, leading to issues regarding change management and slow uptake from staff (if at all). This could easily be mitigated against my bi-weekly or monthly innovation 'email blasts' or something similar to the company to keep staff up-to-date. Alternatively, data pertaining

to vision and associated innovation projects could be made available to the staff on an intranet or SharePoint page, so that those who wished to know could find out project progress whenever they liked. Either of these would go along way to increase open communication and limit staff resistance.

4.2.2 Innovation success evaluation

Currently, it is not possible fully evaluate the success of this innovation as its development is too recent. However, a number of success criteria can be established which refer back to the main drivers outlined in section 2:

Has this innovation met our clients satisfaction? Are they confident to use it?: Initial client feedback from demonstrating a number of different prototypes has been positive. These clients understand the value of connecting multiple databases together into a single visualisation tool that allows them to interrogate their/our data. At present, this positive feedback constitutes an initial success and suggests the final version of the visualisation tool is likely to be commercial, or at least welcomed by PetroStrat's client base.

Has this innovation provided us with a competitive advantage: Presently, it is too early to tell. Certainly, it has allowed us to compete and keep-up with a small number of competitors who were moving into this visualisation space. By this metric, this innovation has been successful, but it will take a longer period of time to assess if PetroStrat has developed a competitive edge through this innovation.

Has this innovation Increased reporting/analytical efficiency and associated personnel-time savings: Again, it is too early to tell if this innovation will bring significant efficiency in terms of reduced analytical and reporting time. Certainly, the semi-automated approach to bring multiple datasets together and run automatic statistical analysis should provide benefits including efficiency (through reduced analytical/reporting time) and consistency between operators. Once the final product is deployed, a simple comparison between the 'old' vs. the 'new' way (i.e., using this data visualisation tool) to analyse the same dataset should determine if the innovation has been successful in terms of increased reporting efficiency.

5 References

Business Wales upskilling

<https://businesswales.gov.wales/skillsgateway/flexible-skills-programme> [accessed 26/05/22]

Das, p., Verbung, R., Verbraeck, A., and Bonebakker, L., (2018) Barriers to innovation within large financial services firms: an in-depth study ubti disruptive and radical innovation projects at a bank. European Journal of Innovation Management (Vol. 21). Emerald Publishing Limited

Dover, C., (2004) How dashboards can change your culture. *Strategic Finance*, 86, pp. 42

EU adaptation of Technology Readiness Level:

<https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels> [accessed 26/05/22]

Few, S., (2006) Information Dashboard Design: The effective visual communication of data (Vol. 2). Sebastopol, CA: O'Reilly

Herrera, M, E, B., (2016) Innovation for impact: Business innovation for inclusive growth. Journal of Business Research (Vol. 69). Elsevier

Innovate UK:

<https://www.ukri.org/what-we-offer/our-main-funds/industrial-strategy-challenge-fund/> [accessed 26/05/22]

SMART Cymru

<https://businesswales.gov.wales/innovation/smart-innovation> [accessed 26/05/22]

Technology Readiness Level:

https://www.nasa.gov/directorates/heo/scan/engineering/technology/technology_readiness_level [accessed 26/05/22]