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ABSTRACT

After years of increasing activity and stable high energy prices have an increasingly higher cost made it necessary to restructure and streamline the industry. This need has been reinforced by a significant drop in oil prices. Across industries, the digitalization technology with all the new digital tools with amazing new capabilities are becoming available, is a growing market with unimagined possibilities.

For many companies in the Oil and Gas industry, several improvements related to digital technology represent the best options to achieving strategy goals and seems to be the obvious way to go to be competitive. Smarter use of data is increasingly among the important priorities, since the industries has access to greater volume of data than ever before.

Despite several studies and research of how to improve projects and to measure the project performance, many projects around the world still finish later than expected and with higher cost. This case-base study has examined the improvement opportunities for project performance in connection with industrial digitalization.

Performance management and performance measurements are used in one way or another in the Oil and Gas Industry. In some area it is developed well in other there are several improvements opportunities. One opportunities are how projects may utilize the enormous amount of data available. For project performance in the Oil and Gas industry the relevant information and key data can be presented in a way that it may contribute to better safety, decision making, resource needs - and give higher value.

For a company like Equinor ASA the investment of digital solutions for project execution may give several new possibilities to perform even better and to have a good overview of the status and performance. By utilising data and information from several applications, merged together to get a better visualization, which gives a better understanding and supportive information to decision makers.

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The months I have spent working with this Thesis have been challenging, but most of all exciting, educational and I have acquired a lot of new knowledge. The master program has been very valuable learning with the combination of technical and managerial disciplines. It has required me to bring my work experience into the study, which has given the program an added relevance and interest. In addition, having classmates that have similar background and circumstances have improved the experience.

During my work with the assignment there have been several people who have helped me and contributed with input that I would like to thank. Especially the team in the internal digitalization project for sharing their knowledge and experience from the projects they are working in. I also want to express my gratitude to my supervisor in Equinor for great guidance and support throughout the work with this Thesis. I feel the selection of the topic has been spot on in terms of relevance and knowledge that is vital going forward.

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ABBREVIATIONS AND DEFINITIONS

AI	Artificial Intelligence
ARIS	ARIS the name of Equinor's process-based management system
ATS	Agreement for Technical Services
AO	Arbeidsordre (work package)
BI	Business intelligence
BSC	Balance Scorecards
Company	Means the project organization responsible for executing the Project
CPR	Completion Preparation Responsible
Contractor	Bidder who has entered into a Contract with Company to perform the SOW for a Project
DG	Decision gate
EPCI	Engineering, Procurement, Construction, Installation
FAT	Factory Acceptance Test
FR	Functional requirements
GL	Guidelines
HSE	Health, safety and the environment
IAOG	International Association of Oil and Gas Producers
IoT	Internet of Things
KPI	Key Performance Indicators
MC	Mechanical completion
MCCR	Mechanical Completion Check Record
ProCoSys	Is Equinor's Project computerized system and software tool for documenting project completion.
LCI	Life Circle Information
PSA	Petroleum Safety Authority
Punch-List	A listing of deficiencies to the Project specification on which the Suppliers, Contractors and Company records any outstanding work and responsibility to rectify.
QRM	Quality and risk management
RBI	Risk-based inspection
RFCC	Ready for Commissioning Certificate
RFOC	Ready for Operation Certificate
SAP	Computer based system
SIT	Site Integration Test
TR	Technical requirements
WO	Work order
WR	Work requirements

1. Introduction

1.1 Background

Almost every industry is focused on exploiting data for competitive advantage (Svahn, Mathiassen, & Lindgren, 2017). The volume and variety of data have exceeded the capacity of manual analysis, and in some cases exceeded the capacity of conventional databases. At the same time, computers have become more powerful, networking is available everywhere, and algorithms have been developed that can connect data applications to enable broader and deeper analyses than previously (Provost & Fawcett, 2013).

Smarter use of data is increasingly among the important priorities of many Oil and Gas companies (GL, 2018a). Data transformation in the Oil and Gas projects has escalated the latest years, and a greater awareness of the potential benefits of information needed. For project performance in the Oil and Gas industry the relevant information and key data can be presented in a way that it may contribute to better safety, decision making, resource needs - and give higher value.

Equinor is one of several major Oil and Gas companies that sees the potential of utilizing the available real-time data when planning and executing both large and small projects. In 2018 Equinor is executing a large portfolio of complex projects. Each of these projects are making some manually and some degree of automated performance overviews to measure status and major challenges in the project.

Several projects members in the company have proposed simplified status overview of project, a common follow-up system with more standardized and automated work processes. New opportunities for utilizing the data in a better way and have a 'lean approach' to current project management practice due to its benefits related to time and resources. The purpose of the performance dashboards is not to provide more information but to provide the right information to the right person at the right time. (Kerzner, 2017)

1.2 Challenges

After years of increasing activity and stable high energy prices have an increasingly higher cost made it necessary to restructure and streamline the industry. This need has been reinforced by a significant drop in oil prices.

While introducing digital solutions to project there may be significant technological compatibility challenges. Old and proprietary systems impose limitations as different standards mean that the systems do not work together.

There are several challenging issues in the project execution phase, related to contractual specifications, planning, quality control, work execution, working with contractors and decision-making process. By introducing new working methods and digital reporting, several important stakeholders may find this implementation disturbing and will not support the solution.

The Oil and Gas Industry has access to a greater volume of data than ever before (NTNU, 2017, May 30), it faces challenges accessing its potential, mainly due to data arriving from different application, different companies, in dissimilar formats, and at various speed and accuracy. There may also be challenges in relation to data input, for example, if the contractor and supplier does not enter data immediately. Then the status of reality and data will not match.

This may indicate that developments in digitization in some areas have a tempo where the industry faces challenges in maintaining a reasonable balance between value creation and risk. This can be linked to the introduction of digital technology is largely driven by efficiency considerations and that the negative effects of introducing large-scale digital technology may not be sufficiently prioritized and accounted for.

1.3 Scope and objective

The purpose of this Thesis is to study several Oil and Gas project with focus on project management, project performance and measurement. There are expectations towards the industrial digitalization, how to exploit these improvement opportunities will be examined.

An internal digitalization project initiative in Equinor attempt to exploit the technological opportunity that digitalization provides. To improve and compensate for the increasing complexity and cost performed in Oil and Gas Projects. This also seems to have a considerable potential in making the project management process more lean.

To fully understand the projects needs and challenges brought on by the enormous information and data in the project execution, an analysis of current practice and desire to be state will be done. Performance measurement are often manually made in the ongoing projects, how to take the first step towards automated performance dashboards in execution phase will be examined.

Therefore, a study of the information and data flow used in several projects in the execution phase are done. Further elaborate how this can improve information access for stakeholders / decision makers.

An evaluation on how to get the dashboard dynamic and predictive, which allows the system to suggest actions and possible solutions to project challenges will be examined.

Developing and producing project performance dashboards is something that several industries are doing, a quick overview of types and the methods used will be presented.

1.4 Methodology

Data has been gathered from many sources using several different methods, which is supported by the case-study method (Yin, 2011). Case-study method is depending on the situation using several other methods like experiments, quantitative modelling to analyse archival data, histories, and qualitative methods.

This Thesis will primarily use qualitative methods (Lincoln & Lincoln, 2005). Qualitative research method is based on human interpretations and is constructed by the intimate relationship between the researcher and what is studied. Some of the characteristics of qualitative research is naturalistic, emergent and purposeful. Meaning it refers to real-world situations, with the possibility to adapt the analysis as more knowledge is gained or situations are changed, and the cases selected is relevant to the topic (Lincoln & Lincoln, 2005).

The case-based research gives the researcher flexibility and adaptability to change direction as a result of revelation of new data and new insights (Yin, 2011) and has been a common aspect during the work with this Thesis. New insights and revelations from articles, survey reports, and real-life examples has been studied during the period, which have resulted in minor changes in the direction and some changes in sources. A challenge has been to assess the relevance of new sources and set a definite limit of including new ones.

The literate review is based on analysis of books, contractual document, papers and report studies. With theory of project management, project performance management and measurement. Some selected projects in Equinor was studied and analysed to point out current state and the desired state for the performance management system used in the execution phase, by looking into the contracts and evaluate the key performance indicators and contractual incentives.

Especially two survey report are essential in this Thesis, one related to best practices and lessons learned after ten years of digital oilfield implementations (Saputelli et al., 2013) this was used in the analysis and improvements ideas chapter. Chapter four have been structured in accordance with this survey report. The other report are from PSA related to digitalization called, " Digitalisering i petroleumsnæringen " (PSA, 2018).

Reports from projects and expert opinions has been given from several people in the company. The writer is participating in an ongoing Oil and Gas project and are also participating in an ongoing internal digitalization project initiative, experience from these projects have been utilised.

1.5 Limitations

This Thesis data and information base consists of findings from books, literature searches, as well as interviews and workshops. The knowledge overview provided by literature searches is limited by the sources that is possible to find and which can be considered reliable. The knowledge overview from interviews and workshops is limited by the fact that interview objects and participants at workshops constitute a limited selection of Oil and Gas industries, and the results from these will be subjective and coloured by their own experiences.

Manly this Thesis will be limited to information and data from project execution in the Oil and Gas industry. There are several ongoing digital initiatives in the Oil and Gas industry related to project performance dashboards and how to be more efficient in the execution phase with extensive use of real-time data. The writer has only access to limited information from other companies.

When looking into what a project need, and expectations related to the improvement of performance measuring, there are several elements that need to be examined. In this Thesis it is not possible to cover all the aspects of performance measurement in the project. Therefore, the analysis has been concentrating on the project execution phase. There is a limitation related to using project data from the same organisation, which makes it impossible to benchmark the data with data from similar organisations. Therefore, benchmarking as a performance measurement has only briefly been mention. This has a negative impact on the external validity since some of the findings in this research cannot be generalized.

To cover all the technical aspect related to digitalization will not be done in this Thesis, the focus for digitalization is related to what kind of digitalization initiatives may have interest in the project execution phase in an Oil and Gas project.

There are a lot of digitalization initiatives in other sectors and industry, and probably some of the same technology of sharing and using information and real-time data. How the Oil and Gas industry will be able to utilise the effect of a good dashboards in the project execution phase, has not estimated.

1.6 Structure of the work

This Thesis is presented in seven chapters in total, where each is divided into sub-chapters.

Chapter 1 introduce this Thesis, and provides information about background, challenges, purpose, methodology and limitation.

Chapter 2 covers the literature review, highlighting digitalization, project and project management and performance measurement – including performance dashboard.

Chapter 3 consists of the introduction to the Oil & Gas Industry, and how Equinor performs and measures projects.

Chapter 4 covers the analysis and improvements ideas, and each sub-chapter reflects on the scope and deliveries.

Chapter 5 presents additional recommendations.

Chapter 6 and 7 presents the discussion and conclusion of the research. They address findings and implications.

2. Literature review

The aim of the literature review is to obtain an overview of theory and research, related to project management, project performance and performance dashboards and digitalization.

The review starts with a chapter on digitalization - then some principal aspects of projects and project management process, and then performance dashboards.

2.1 Digitalization

This section is a theoretical foundation when it comes to the use of digitalization and buzzwords in this Thesis. Digitalization is not something new. What's new now is that the technological development is going so fast, that still new areas can be digitalised and reaches something is digitalised, the development takes place exponentially. The oil crisis, and the focus on cost-effectiveness that followed, has boosted digitalization in the industry.

Each year, the consulting and verification company DNV GL, makes a report on the prospects in the Oil and Gas industry. In recent years, it has also included a separate chapter on digitalization. In 2017, 49 percent of the companies said that digitalization was necessary to earn more money. This year, the share increased to 70 percent. Today's increased awareness of digitalization is linked to the industry's pursuit of higher cost-effectiveness (GL, 2018a).

The Fourth Industrial Revolution, Industry 4.0, describes the transition to a “smart” industry. To achieve this, eventually the entire supply chain is accessible and controllable through the Internet. This applies to reading sensor values from an individual machine, as well as to communication with the external environment and other assets in the trade.

Digitalization

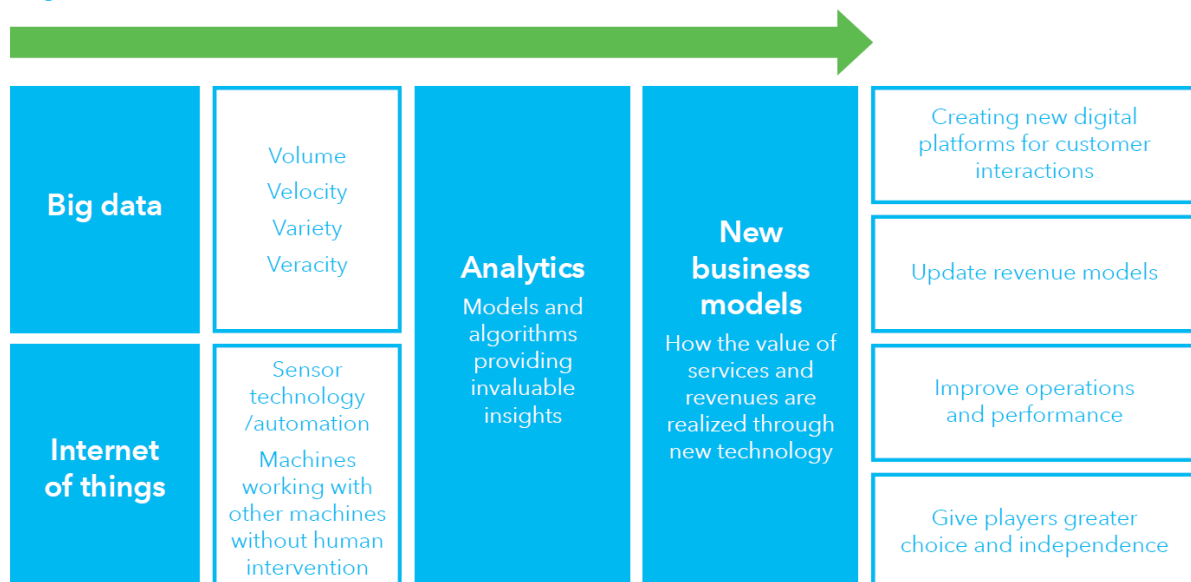


Figure 2. 1 Big Data technologies are enabling the Oil and Gas industry to embrace the digital transformation (GL, 2018b).

The Internet of Things (IoT) is the network of identifiable objects equipped with electronics, software, sensors, actuators and networks that enable the objects to connect to each other, and exchange data. But smart things on the Internet (IoT) require more sophisticated communication. Over the past 20 years, middleware and server systems have grown to handle the ever-increasing need for two-way communication.

The ability of objects and equipment to transmit large amounts of data - often described as 'Big Data'. Big Data can be defined by using the 4 Vs: volume, velocity, variety and veracity (Figure 2.1). Big Data is about collecting and analysing large amounts of data, using technologies such as data models, pattern recognition and artificial intelligence. Big Data is often defined as large amounts of data with great information variation and change over time.

Big Data and IoT technologies are enabling the Oil and Gas industry to embrace the digital transformation (GL, 2018b). Figure 2.1 illustrate this good with illustrating the opportunities that Big data and Internet of things gives the Oil and gas industry. By using this input to do analytics that may led to new business models. Which can give an improved operations and performance.

In this Thesis Big Data is used to describe the utilisation of data information that is available in a project. This data is not used anywhere close to it's potential. There is a growing awareness of data analytics as a strategic technology. The Oil and Gas industry has traditionally focused on model-based techniques, where physics is embedded into models, examples being seismic inversion models and reservoir simulation models. However, it allows a wider range of methodologies, data-driven analysis - either as a standalone methodology, or in combination with model-based techniques (NTNU, 2017, May 30).

Artificial Intelligence (AI) is evidently helping many firms to exploit their existing sources of advantage, whether through process automation, improved problem-solving or quality assurance. Newer AI technology uses methods where machines learn by themselves or with human assistance. That means the more data it gets fed, the better it will become to recognize patterns to improve its cognitive abilities. The timing of this breakthrough in machine learning coincides with other digital developments. Stronger computing power with reduced costs is believed to be the most significant factor, and cloud computing has opened the way for more AI research with smaller budget. In addition, more data is generated than ever before through digital videos, texts, pictures, sensors, and so on (Brynjolfsson & McAfee, 2017)

Predictive analytics encompasses a variety of statistical techniques from data mining, predictive modelling, and machine learning, that analyse current and historical facts to make predictions about future or otherwise unknown events. In business, predictive models exploit patterns found in historical and transactional data to identify risks and opportunities. Models capture relationships among many factors to allow assessment of risk, or potential associated with a particular set of conditions, guiding decision making for candidate transactions (Provost & Fawcett, 2013).

2.2 Projects and Project management

Equinor is a company that has its core business through projects, operations and development. Therefore, the literature study is based on a brief introduction as a theoretical aspect, to get an understanding of Project management process and Performance management further study of this theme will be done in chapter three.

There are many different perceptions and definitions of what a project is. The majority appear to agree on the basic principles, and three elements are often drawn. Firstly, the task must have a goal, this must be beyond routine goals. Secondly, a project is a one-time assignment and, thirdly, the project must have some meaning, the task must be done within the given time and resources.

Projects as working methods are used constantly in all areas, in industry and in the overall society. Using a project as a working form creates opportunities for increased goal management, customer focus and flexibility that is not possible through traditional organizational feasibility. It is possible to approach projects from different perspectives, this Thesis will focus on Oil and Gas projects, which easily elucidate important aspects such as time, cost, resources, scope, Health, safety and the environment (HSE) and quality in project work.

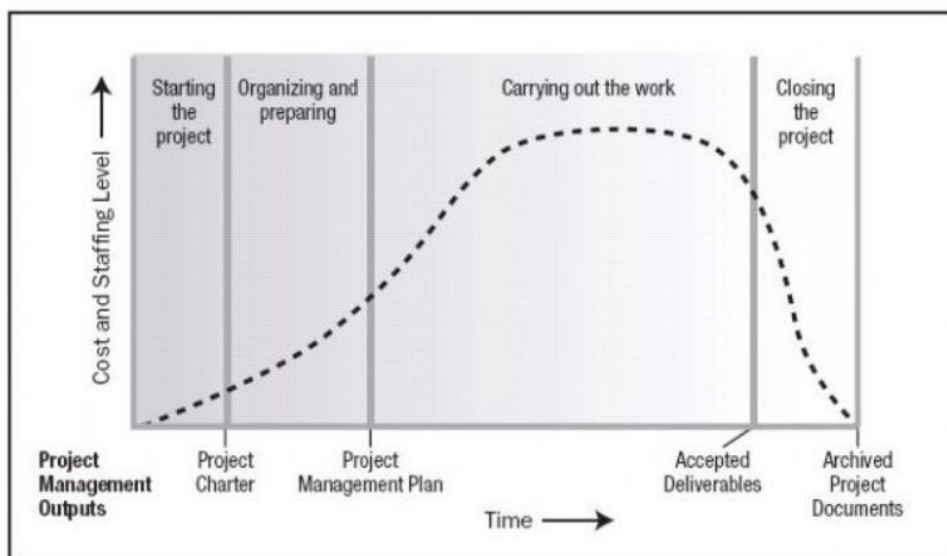


Figure 2.2 Source: PMBOK® Guide (Institute, 2017)

A project has a natural life cycle, which is divided into phases. Each phase represents the main activity being conducted in that period. The phases are often comprised of smaller, more precise activities or objectives. The life cycle includes; starting the project, organizing and preparing for the execution, carrying out the work, and closing the project. Figure 2.2 Indicates a typical project life cycle, where the phases are separated by vertical lines. Note that the vertical axis represents cost- and staffing resources required in the project. Executing the project requires the highest amount of resources.

2.2.1 Project management

Proper project management methodology is the key to any project success. Successful solutions are founded upon professional project management for complex system integration projects. Successful project management requires a precise set of skills, knowledge, flexibility and creative problem-solving. Experienced project managers know that along with years of experience, comes a greater understanding of the complex interrelationships between all parts of a project, from set-up to completion. Several organisations have made their own standards and abbreviations to guide project management to success.

A well-known standard is “A Guide to the Project Management Body of Knowledge” (PMBOK® Guide), from the Project Management Institute (PMI) USA. This standard provides a best-practice approach to tackling project management challenges across the industry at all professional levels. (Institute, 2017)

The Organisation from UK, called Axelos Limited, is the other of the most recognized organisations. And the standard is called Management of successful projects with PRINCE2. PRINCE2 is most prevalent in the IT industry, the public sector and companies that work with product development.

PMBOK® Guide is most common in Oil and Gas Industri, and in building and construction sector. The PMBOK® Guide refers to Project management knowledge areas that is coincide with the process groups, which are project initiation, project planning, project execution, monitoring and controlling, and also project closing. These are the phases that every project goes through (Institute, 2017). Figure 2.3 illustrate a Project with Overlapping Phases from engineering/design to construction (Guide, 2001).

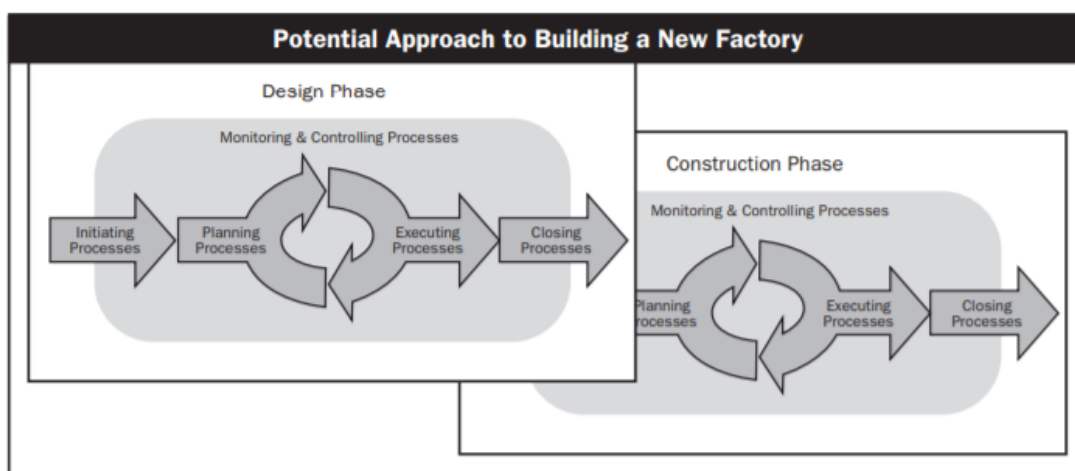


Figure 2.3 Example of a Project with Overlapping Phases (Guide, 2001)

Managing a project is unique from one project to another. However, some typical tasks include identifying requirements, addressing needs, concerns and expectations of all stakeholders, managing communication among stakeholders, and balancing constraints – steering the project towards a set goal (Institute, 2017).

2.2.2 Performance management and measurement

According to the Project Management Institute (pmi.org), a project is a “temporary endeavour, undertaken to create a unique product or service”. Temporary means that every project has a definite end. Unique means that the product or service is different in some distinguishing way from all similar products or services.” Because they are unique, projects cannot be controlled like normal processes that are identically repeated hundreds, or even millions of times.

Each project goes, as indicated in chapter 2.2.1, through a standard lifecycle (Figure 2.2), composed of five main phases: initiating, planning, executing, controlling, and closing. Thus, each time a new project is established, we need to develop a new project plan in terms of scope, activities, resources, time, and risk. This plan will then become the reference point for the controlling activities (Buganza, 2015).

That’s why there is no universal performance management system with established goals and measurements that are appropriate for all organizations. The system must be developed in the context of its use. However, many books and standards have been published, describing different frameworks for how to design own performance management systems, and which recommended principles should be found in such a system.

Kaplan and Norton's books *The Balanced ScoreCard* (Kaplan & Norton, 1996) and *Strategy Maps* (Kaplan & Norton, 2004) are some of the most recognized and used framework for designing performance management systems. Balanced Scorecards (BSC) describe long-term focus, short-term actions, how to measure these and the target for the item. It gives numbers for the management to quickly get the overview of the situation and helps to focus on the right items and to make the right corrections at the right time.

Balance Scorecard complements financial measures of past performance with measure of drivers of the future. Innovative companies are using the scorecard as a strategic management system, to manage their strategy over their long run. They are using the measurement focus of the scorecard to accomplish critical management processes:

1. Clarify and translate vision and strategy
2. Communicate and link strategic objectives and measure
3. Plan set targets, and align strategic initiatives
4. Enhance strategic feedback and learning (Kaplan & Norton, 2004)

To manage the project performance, what kind of factors and leading indicators to be controlled, needs to be defined. In the past, projects were concentrated on quality, progress and resource. Today, we expand the management factors to: Quality, Progress, Resource, Cost, and Health, safety and the environment (Kolltveit & Reve, 2002).

2.2.3 Key Performance Indicators

Key performance indicators are used by projects to evaluate performance, and as a result, always strive to be at their best and can help a project to achieve the objectives they have.

By implementing indicators for measuring performance, it is possible to monitor if they are going in the right direction and achieving targets in the project are met. It can also be used for making quick decisions, to help you stay ahead of your competitors.

KPI is useful, but focusing on the wrong metrics can be detrimental, as time and money are spent measuring, monitoring and trying to optimize metrics that does not matter much. Poorly structured KPIs, or KPIs that are too difficult and costly to obtain, or to monitor on a regular basis, will not help the project.

Yun, Choi, Oliveira, and Mulva (2016) have in their study developed a performance metrics for phase-based capital project benchmarking and created an overview of KPIs, see Table 2.1. This table indicates that cost, schedule, and quality (scope is considered part of quality), HSE (Safety performance) are the most frequently used KPIs for measuring the performance of projects.

KPI	Cox et al. (2003)	Yeung et al. (2007)	Luu et al. (2008)	Skibniewski and Ghosh (2009)	Rankin et al. (2008)	Ling et al. (2009)	Swarup et al. (2011)	Almahmoud et al. (2012)	Yeung et al. (2013)
Cost performance	X	X	X	X	X	X	X	X	X
Schedule performance	X	X	X	X	X	X	X	X	X
Quality performance	X	X	X	X	X	X	X	X	X
Safety performance	X		X	X	X			X	X
Customer satisfaction			X	X		X	X	X	X
Change (scope) management			X		X			X	
Productivity	X			X					
Profitability				X		X			
Sustainability					X				X
Effective communication		X							X
Innovation and improvement		X			X				
Unit cost	X								
Top management commitment		X							
Trust and respect		X							
Project team			X						
Material management			X						
Predictability of cost and schedule				X					
Public satisfaction						X			
User's satisfaction									X
Functionality									X
Planning effectiveness									X

Table 2.1 Summary of Key performance Indicators (KPI) in the previous studies (Yun, Choi, de Oliveira, & Mulva, 2016)

2.2.4 Contractual incentives

John McMillan in “Games, Strategies, and Managers” claims that contractual incentives are necessary due to two main components:

1. Divergence of interests: what Company wants to do is not exactly the same as what Contractor wants to do.
2. Company’s inability to disentangle the effects of Contractor’s effort, from random factors independent of the Contractor. In other word - is Contractor’s output an imperfect measure of his effort due to unforeseen, uncontrollable issues affecting Contractors performance. (McMillan, 1996)

The purpose of the Contract incentives is to align the Contractor reward structure as close as possible, up to the interest of Company. This way both Company and Contractor benefits from reaching the same goal; their interests are aligned. Incentive is a mechanism that can be used in contracts and have the intention to make the supplier allocate his recourses and method of operation to improve the result of the project.

A good result demands that the parties have a shared view on the impacts of the incentive scheme. The incentive schemes have to be easy to evaluate and manage. General incentive regulates the interaction between the two parties in the contract, the owner and the supplier. In contractual relation we can relate to two extreme points - the conventional contracts with a large distance between the two parties, and the other extreme point, an alliance where the parties have a close collaboration.

In the middle of the two points of view is the rational contract. The parties have frequent collaboration but stick to the distribution of responsibility that is drawn in the contract. The incentive intensity in the contract depends on the owners request to influence the suppliers work and the importance of the result of the work, often with a specific goal or milestone.

2.2.5 Stakeholder engagement

Strong, mutually respectful relationships with key stakeholders are essential for all business success. It is important to communicate with and engaging stakeholders, to keep up with their evolving priorities and concerns in the business and inform them of what is going on. Stakeholders may be defined as any individual or organisation who is either directly or indirectly affected by Company’s actions or who can impact or influence Company’s decision making.

Typically, stakeholder can be:

- Governments and regulators
- Shareholders, lenders and analysts
- Business partners, suppliers and contractors
- Communities
- Non-government and industry organisations

Target interactions and communications is to meet the information needs and expectations of different stakeholders. All members of management team play a key role in stakeholder engagement.

Methods of engagement:

- Engaging stakeholders regularly, honestly, ethically and constructively about all matters of importance to them and the Company.
 - Ensuring they are sufficiently informed about plans and are adequately consulted.
 - Being accessible and responsible, and engaging in a culturally appropriate manner
- Proactively monitoring emerging issues and trends.

What roles involved in a project depend on the project approach chosen and the size and complexity of the project (Gardiner, 2005).

2.2.6 Project follow-up and Close out

When starting a project, a strategy is made for the project to decide the needs for recourses to ensure delivery and quality. A tool used to evaluate the needs is a risk-based inspection (RBI) programme. This programme is an integrated methodology that uses risk as a basis, based on the criticality of the item, by combining the likelihood of failure and the consequence of failure to identify potential deteriorations at an early phase(Faber, 2002).

RBI highlights that inspections may be used as a tool, to reduce the uncertainty in the predicted deterioration and/or as a mean of identifying deterioration and defects before it becomes critical.

Faber indicate that RBI is based on rational and cost-efficient decision framework for determining and comes with the following guiding:

- Where to inspect: decide which system, where on the system?
- What to inspect: Criticality with respect HSE, cost?
- How to inspect: inspection method?
- When to inspect; scheduling?
- Documenting the requirements to HSE
- Guidance to what action to make on results; no detection or detection: no action, monitoring, repair, replacement (Faber, 2002)

Other well-known methods that are used to ensure project execution follow-up strategy, is standardisation, best practise and experience transfer.

(Ringen, Aschehoug, Holtskog, & Ingvaldsen, 2014) defines standardisation as a way of dividing work per scope, schedule, time interval and quality of the output of a process. The idea behind standardisation is to perform work following what is decided to be best practice. Standardisation is applicable in any organization, regardless of industry, although it is easier in some industries than others.

Best practice of methods used in the industry, are done by documenting ideas and disseminating the knowledge of the rest of the organization, then the organisation can benefit from the idea several times, and eventually optimize it. The idea of best practice is based on how to perform a specific task, there is a method, process, technique or activity that in most cases will produce the best results with the least possible challenges. And which is more efficient than other approaches (Kerzner, 2014).

What is best practice will change over time, according to technological development and general societal and market development. Therefore, an organization's approach to best practice should also take shape as a continuous optimization process. This is to ensure that the organization is maintaining a competitive advantage of its best practices.

Experience transfer, is about taking along and disseminating inputs, ideas and knowledge acquired during previous projects, which can help improve the organization's future value creation. The experience reports from the selected projects have been reviewed to secure that the experience from these earlier projects will be evaluated. In the contract it is specified that an experience transfer report must be made. It says that Contractor shall prepare close-out information at contract start up and record experience data on a continuous basis in collaboration with Company. The close out report shall include a general section, HSE, qualitative and quantitative. The general section shall describe experiences gained related to the Scope of Work in the contract, supported by key figures, lay out drawings, sketches etc. as applicable, and requirements to HSE, qualitative and quantitative.

2.3 Performance Dashboards

A performance dashboard provides information and insights that enable the business users to improve decisions, optimise the process and plans and work proactively. Strategic objects are communicated, and business managers are enabled to measure, monitor and manage key activities and processes needed to achieve their goals (Eckerson, 2010). For the performance dashboards to do this in a god Eckerson have mention three sets of main functionalities:

1. *Monitor* - critical business processes sand activities using matrix that triggers alerts when performance falls below predefined targets.
2. *Analyse* - the root cause of problems by exploring relevant and timely information from multidiscipline perspectives at various levels of detail.
3. *Manage* - people and processes to improve decisions, optimise performance, and steer the organisation in the right corrections.

Even performance dashboards have a history and is simply a new name for Executive information system (EISs) that were first developed in the 1980s (S. Few, 2013). During the 1990's, data warehousing, online analytical processing and all the way to the so-called information age.

The emphasis during these years was to collect, integrate, store and access data. What also emerged during the 1990s is the new approach of management that involved identifications and use of key performance indicators (KPIs) this method introduced by Robert S. Kaplan and David P. Norton is known as the balance scorecard. The advantage in data warehousing and related to technologies sets the phase for the interest in management by using metrics, not just financial metrics, that dominates the business landscape today.

Business performance measurement become an international preoccupation. And the interest from Business performance measurement for the easily monitored metrics, is the hibernating seeds of the executive information system / dashboards type that were once again able to grow. Now performance dashboard is used in several industries and sectors and is often displayed on a web page which is linked to a database that allows the report to be constantly updated with real time data (S. Few, 2013).

For example, a manufacturing dashboard may show numbers related to productivity such as number of parts manufactured, or number of failed quality inspections per hour. Similarly, a human resources dashboard may show numbers related to staff recruitment, retention and composition, for example number of open positions, or average days or cost per recruitment.

Several companies have seen the need to organise and structure the data available.

Business balanced scorecard is much of the same as dashboard (Person, 2013) . The book from Person describes the step from strategy maps and balancing scorecard to operational dashboards tool that measures that show how to accelerate operational success.

The primary difference between dashboard and scorecard is that dashboard monitor performance op operational processes whereas scorecard chats progress toward achieving strategy goals. Table 2.2 are listing some difference between the terms.

	Dashboard	Scorecard
Purpose	Measures performance	Charts progress
Users	Supervisors, specialists	Executives, managers
Focus	Act	Review
Updates	Intraday/daily	Weekly/monthly/quarterly
Data	Details	Summaries
Display	Charts/tables	Charts/comments

Table 2. 2 Dashboards versus Scorecards (Eckerson, 2010)

2.3.1 Examples of performance dashboards

Developing and producing project dashboards is something that several industries are doing, here is a quick overview of three different types. It is not intended to be either positive or negative to the examples. It is mainly to introduce how these dashboards can be designed with different methods. But figure 3.5 are a dashboard Stephen Few decided to use in his book *Information Dashboard Design* to point out practices that business must avoid if they care about improving business intelligence in the coming year (S. Few, 2013)

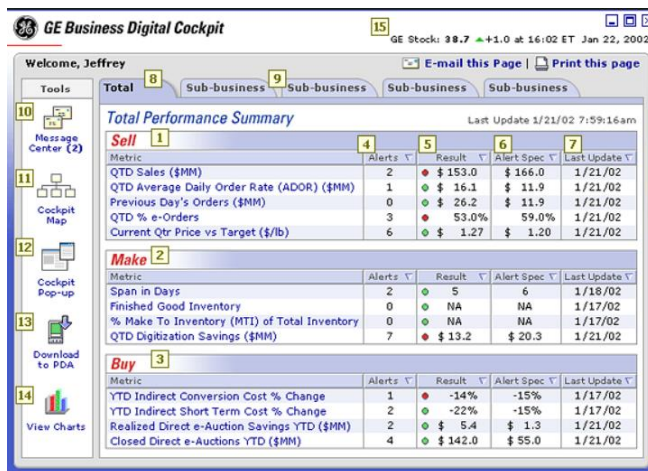


Figure 2.4 Dashboard from General Electric, called a digital cockpit (GE, 2001)

Figure 2.4 is a dashboard used by General Electric; To Our Share Owners, Customers and employees. Called a digital cockpit, it provides an overview of performance, completed by a color-coded indicator light for each measured status. GE promotes that digitization allows them to be more efficient, competitive and agile in the marketplace by giving GE executives mission critical information on a real-time basis.

The Digital Cockpit is part of a three-pronged e-Business strategy called Make, Buy & Sell that is focused on internal productivity, external sourcing and customer workflow. And this sample Digital Cockpit is used to click any numbered box in the image to learn about a specific section or scroll down the page to read more.



Figure 2.5 example of a management dashboard shows an overview of key information (Briggs, 2014)

This example (Figure 2.5) of a management dashboard shows an overview of key information. Note the summaries of multiple departments, which can be crucial for decision-making. This is a dashboard that was designed by an organisation for its own use

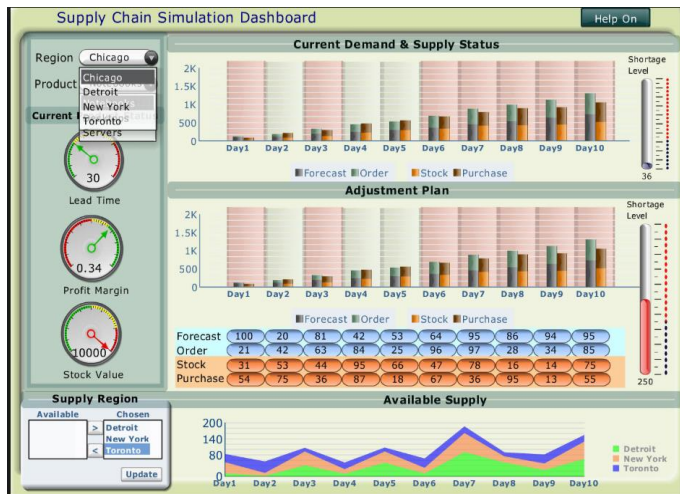


Figure 2.6 illustrates the theme that has dominated most Business intelligence data visualization, anaemically presented data, tainted with distracting visual nonsense.

Figure 2.6 Screen shot of the winning solution to produce dashboards. (Stephen Few, 2006)

A contest was held to create an original interactive data presentation or business dashboard. With two requirements, use using any Crystal Xcelsius™ product and the Dashboard must attempt to serve some kind of business function. “It appears that Xcelsius picked winners on the basis of how many Xcelsius widgets they showed, and not the best examples of visualization.” is the conclusion from a business manager (Stephen Few, 2006).

2.3.2 How and why design dashboards.

The purpose for dashboards is not to provide more information but to provide the right information to the right person at the right time. (Kerzner, 2017)

The international Business Communication Standards (IBCS) have practical proposals for the design of business communication, this standard is used in the dashboard design. The standard has several examples of how to present proper conceptual, perceptual and semantic design of charts and tables in reports, presentations and dashboards.

The standard states the all dashboards are pages of an interactive analytic system designed to achieve a high rate of visual perception. Time necessary for the reader to oversee und understand the situation illustrated by the charts and tables is a valid quality criterion (IBCS, 2017).

The performance dashboards have a real-time database, a database system which uses real-time processing to handle workloads, whose state is constantly changing. Differs from databases containing persistent data, mostly unaffected by time. When using the dynamic dashboard term, indicate that the dashboard uses a Business Intelligence platform that monitor the users navigational, and enable the user to immediately recompile the information shown according to their preference. Like an interactive system that dynamically updates its views based on the user’s choices and allow the user to immediately perform own analysis. While it was previously a challenge to get sufficient production data, the challenge now is to develop and implement decision support tools and work processes that can exploit the massive amount of data available(Saputelli et al., 2013).

Dashboards are not that different from other information presented, but “Dashboards and visualisation are cognitive tools that improve your “span of control” over a lot of business data. These tools help people to visually help guides then towards effective decisions. As such, these tools need to leverage people’s visual capabilities. With the prevalence of scorecards, dashboards and other visualisations tools now widely available for business users to review their data, the issue of visual information design is more important than ever.” (Brath.R, et a..2004)

According to Stephen Few, monitoring information to manage performance involves primary phases:

- *Update high-level situation awareness.*
- *Identify and focus on particular items that need attention.*
- *Update awareness of this item in greater detail.*
- *Determine whether action is required.*
- *If action is required, access addition*

There are several characteristics of well-designed dashboards(S. Few, 2013).

These are:

- *Exceptionally well organised*
- *Condensed, primarily in the form of summaries*
- *Specific to the task at hand and customized to communicate clearly to those who will use it*
- *Displayed using concise and often small media that communicate the information in the clearest and most direct way possible*

First when designing a dashboard there are some fundamental considerations according to Stephen Few. The following six features (Table 2.3) of how dashboards *will be used* and by *whom* affect the way they should be designed.

<i>Future</i>	<i>Items</i>
<i>Updated Frequently</i>	<i>Daily</i> <i>Hourly</i> <i>Real time</i>
<i>User Experience</i>	<i>Novice</i> <i>Journeyman</i> <i>Expert</i>
<i>Audience</i>	<i>One person</i> <i>Multiple people with the same requirements</i> <i>Multiple people that need to monitor different data subsets</i>
<i>Technologically platform</i>	<i>Desktop/laptop</i> <i>Web server/browser</i> <i>Mobile device</i>
<i>Screen Type</i>	<i>Extra-large screen</i> <i>Standard screen</i> <i>Small screen</i> <i>Variable screens</i>
<i>Data Type</i>	<i>Quantitively</i> <i>Non-quantitative</i>

Table 2.3 Six features, (S. Few, p. 65, 2013)

To be sure that the design of the dashboards helps the business to be more competitive and indicates the data that gives the company a business advantage.

Stephen Few are listing thirteen common mistakes in Dashboard design in his book *Information Dashboard Design: Displaying Data for At-a-glance Monitoring*.

Some of the common problems and set of design practices that doesn't work are:

1. *Exceeding the boundary of a single screen*
2. *Supplying inadequate context for data*
3. *Displaying excessive details or precisions*
4. *Expressing measures indirectly*
5. *Choosing inappropriate display media*
6. *Introducing meaningless variety*
7. *Using poorly designs display media*
8. *Encoding quantitative data inaccurately*
9. *Arranging information poorly*
10. *Highly important information ineffectively or not at all*
11. *Cluttering the display with visual effects*
12. *Misusing or overusing color*
13. *Designing an unattractive visual display*

(S. Few, p. 35, 2013)

3. The Oil and Gas Industry and Equinor ASA

Chapter three will give a brief introduction to project management and project execution in Equinor. This study will be used to reflect on possible digitalization initiatives and improvements ideas that may be utilised in the project execution phase.

3.1 Investment and cost forecasts in the Oil and Gas industry

In the 1950s not many people believed there was Oil and Gas in the Norwegian continental shelf (NCS). Nevertheless, 50 years later, the Oil and Gas Industry had become Norway's most important industry in terms of investments, income to the state and contribution to GDP (Government, 2016). The Norwegian Oil and Gas adventure really began in 1969, when Phillips Petroleum Company discovered the Ekofisk field, one of the largest offshore oil fields ever discovered.

The production from the Norwegian continental shelf peaked in year 2004, with a production of 4.5 million barrels of oil equivalents per day. Production development in recent years indicates that the fields are producing more than previously assumed. This is the result of efficiency measures, particularly within the drilling of wells and regularity on the facilities.

The Norwegian Petroleum Directorate expects this trend to continue with additional new projects in the time ahead, so that production will come on stream faster than previously thought (Directorate, 2018, January 11).

The forecasted investment 2010-2022 from The Norwegian Petroleum Directorate indicates that several projects will be executed the next years to come. Giving the digitalization initiatives a possibility to be further developed and contribute to better safety, decision making, resource needs - and give higher value in the upcoming projects.

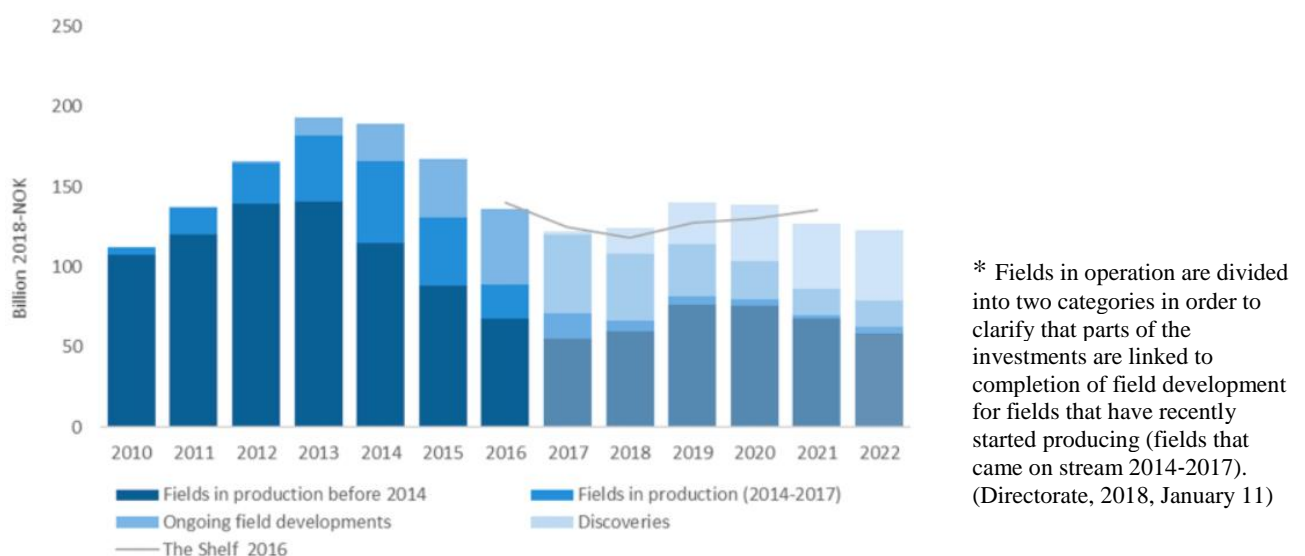


Figure 3.1 Investments excluding Exploration, forecast 2017-2022 * (Directorate, 2018, January 11)

3.2 Digitalization and digital trends in the Oil and Gas industry

What is digitalization in the Oil and Gas industry in practice? And what opportunities does it provide for the project execution phase in Oil and Gas industry?

PSA has published a new report " Digitalisering i petroleumsnæringen " as part of its work on digitization and IT security. It is prepared by the research institute Iris in connection with the PSA project - digitalization in the petroleum industry. The main aim of this project is to provide a better understanding of trends in digitization, the consequences of digitization for human beings, technology and organization, and to make recommendations on strategies and measures to follow this up, says project manager Linn Iren Vestly Bergh, in a comment on the PSA website. (PSA, 2018)

In this chapter some of the findings from this report related to the digital trends in the companies that operates in the Norwegian Continental Shelf.

The report describes how the Oil and Gas industry is increasingly dependent on digital systems and technology and that *key drivers* are technological advancements, cost focus and anticipation of positive HSE effects. At the same time, there are significant barriers to digitization in the Oil and Gas industry. The industry's high security requirements are part of the explanation. The quality of the solutions is also an important element, while commercial considerations are a third reason.

The report shows that the focus today is primarily aimed at further development and use of tools and processes for decision making, interaction and automation improvement. The period in which the industry is, with mature technology and high pressure on efficiency and costs, is described as a "break time" with increased focus on technology development and usage, while at the same time providing older systems and work processes.

The report has categorised the digital initiatives in the industry by the following; robots and autonomous vessels, integrated operations, automation of drilling operation and Digital Oil Field (DOF).

The term Digital Oil Field (DOF) also known by many of its synonyms (Smart field, Intelligent Oilfield, Field of the Future, i-Field, e-Field, Real-time Operations, and Real-time Optimization) DOF is a collective term for the use of software and data analysis to improve the profitability of Oil and Gas Industry and Production.

A lot of the trends in the Oil and Gas industry are related to the working methods and how this improve the installation, safety and quality of the work. These trends will improve the installation methods and will on the other hand be possible to measure on the project performance dashboards.

Experiences with the use of drones for inspection of offshore wind turbines have been good and to expand the use of the drones to do inspection of platforms offshore has been discussed. Also, inspections in the execution phase of the project have been discussed, this may give a good and safe inspection method. By reduce the activities when persons are working in highly risk able area, e.g. when working at heights and over sea.

When it comes to integrated operations, the industry expects a strong pressure on minimizing the number of offshore personnel, this has been looked at for many years, now when even more data is available, it focuses on utilizing the opportunities that digitization provides.

An important trend is the digitization of well planning. A digital model of the well also opens for simulation of the drilling operation. With a digital model are available, there is an opportunity to "drill the well in a simulator" that provides far better information about how robust a drilling operation plan is, as well as better opportunities for learning and experience transfer between teams and projects.

Much of the same experience as the digitalization of well planning is the Digital Oil Field facing. Several companies experience that much data is available, but that this has not been utilized well enough. However, this is a central part of digitisation work in several companies. A major change looking forward is that people who monitor and control offshore facilities will have access to information in a completely different way than today.

For example, a "digital twin" for the plant, which, among other things, is being developed in connection with Johan Sverdrup's development project, will provide far better prerequisites for safe operation. This is already utilized in connection with the monitoring of drilling operations. If the actual well drilled has a significant deviation from its digital twin, the drilling crew will be notified by the system.

Several companies work with solutions to enable their employees to use tablets during the execution of activities, called Digital field worker. Thus, better access to relevant information and at the same time more rigid systems to control work tasks using digital checklists. More formalization in the implementation of work processes is believed to create increased security. There are pilots in the final phase around such technology at several offshore installations, and positive experiences leads to further rollout of technology in the future.

One of the challenge area is that demanding to find all data that may be relevant to do the planning of an activity as it lies in different computer systems, both in structured and unstructured form. The team deals with topics such as production optimization, decision support and operational efficiency. Overall, this can be seen as an attempt to exploit the technological opportunity that digitization provides to compensate for the increasing complexity and cost of tasks that must be performed by fewer and maybe less experienced personnel.

3.3 Equinor ASA

Equinor was established in 1972 and has about 20000 employees. Equinor is an energy company which mainly operates within the Oil and Gas industry, but also in new energy solutions such as offshore wind. The company operate over 40 assets along the Norwegian coastline and is the world's largest offshore operator as well as the largest operator in Norway. (Equinor, 2018a) Since the beginning, Equinor methods, systems and processes have been developed into what they are today.

The market Equinor is facing is constantly changing and competition for licensing and finding are challenging. Typically, in this industry is that it requires very large investments and with a large horizon on the return of investment. The company is very exposed to government / tax regime and volatile prices.

Trends in the market is that the findings are smaller and smaller on the Norwegian Continental Shelf (NCS), which substantiates to examine better safety, decision making, resource needs - to give higher value for the next projects to come.

In every company, processes develop constantly along with new technology, new ideas and new people. Adapting to the fundamental changes which the energy industry is facing is essential to be competitive. (Equinor, 2018b)

3.3.1 Equinor digitalization strategy

This is a brief introduction to Equinor's digitalization strategy. Equinor is establishing a digital centre of excellence and launching a roadmap with seven specific programmes for digitalization in the company towards 2020.

The programs are programmes for digitalization:

1. Digital safety, security and sustainability - Using data to reduce safety risks, improve learning from historical incidents, strengthen security, and reduce the carbon footprint of our operations.
2. Process digitalization - Streamlining of work processes and reduction of manual input across the value chain.
3. Subsurface analytics - Improving data accessibility and analytical tools for subsurface data, enabling better decision-making.
4. Next generation well delivery - Enhancing utilisation of well and subsurface data for planning, real-time analytics and increased automation.
5. Field of the future - Smart design and concept selection by maximising the use of available data and integrating digital technologies in future fields.
6. Data-driven operations - Using data to maximise asset value through production optimisation and maintenance improvements.
7. Commercial insights - Improving analytical tools and data accessibility within our commercial areas to enable better decision-making. (Equinor, 2017)

For almost 50 years Equinor been developing technology to extract resources from some of the most challenging environments in the world, and it has given the Company the mind-set, experience and enthusiasm for implementing innovative technologies. Equinor has already embarked on a digital journey. The digital roadmap and Digital Centre of Excellence will continue helping the company to exploit the opportunities of the future. Digitalization and the use of tablets are key to delivering on this vision.

Innovation, digitalization and use of new technology will be important tools to be able to recover resources that are not profitable today. Rapid development in areas such as robotics, drones and use of 3D will ensure safer and more efficient field developments going forward. (Equinor, 2017)

Several digitalization solutions are tested during the time I spent writing this Thesis.

The Mariner field is one of the most complex fields Equinor has developed. To succeed, the project teams is pushing the boundaries of technology, innovation and imagination. Three drilling and well rigs will be in operation simultaneously and more than 100 wells will be drilled during the lifetime of the field.

Mariner will become the first field in Equinor to fully implement tablets in its operations offshore following a seven-month pilot. “Full implementation of the tablets will contribute to working safely and delivering efficiency in our operations to achieve our vision, a nine-hour time on tool day,” says Trond Austrheim, vice president, production, ‘Time on tool’ are the hours spent working directly on core, value adding tasks. The focus is on optimising time spent on administrative activities and technical problem solving, and minimising idle time, such as time traveling between the office and the worksite.

The future is autonomous, but robotization in the oil industry is nothing new. Although the first automation appeared in the 80s and 90s, today we’re at the dawn of a new age of digitalization. Robots have played an important role in the oil industry for 20 years—the newest robots are leveraging the latest in digitalization to contribute to safer, more efficient operations. Like Eelume, a new type of underwater intervention vehicle with a snake-like body and underwater thrusters that can swim around subsea installations and perform small tasks such as turning on or off valves and filming pipelines to check for faults. (Equinor, 2018c)

3.4 Equinor Oil and Gas Projects management process

A common practice in the Oil and Gas industry is The Capital Value Process, which is the structured approach to project development used in Equinor. The process starts with the first assessment of a business opportunity and ends with the start-up of profitable operations. The process uses phase gates which marks the completion of one phase and the launch of the next phase (Wysocki, 2011).

A so-called decision gate (DG) defines the criteria which must be fulfilled before the project goes to the next phase. The choice on whether to proceed with the project is done at each decision gate, and this process often includes numerous meetings, documentation and quality control. The decision gates ensure that all expectations are understood for the result and that the risks involved are considered. (Equinor, 2018d) The full series of phases, separated by decision gates, is illustrated in Figure 3.2. In this Thesis I will concentrate on the performance in the Execution phase between DG3 and DG4.

Technology, Project and Drilling (TPD) business area in Equinor is accountable for the global project development, well deliveries, research and technology as well as sourcing across Equinor. TPD is organised in the following business clusters: Project Development, Drilling and Well, Procurement and Supplier Relations, Research and Technology. Project Development create Equinor value by planning, developing and executing cost-competitive, safe and predictable investment projects. The description and illustration are from Equinor book (Equinor, 2018d).

The project management process groups include:

- Business identification; The business identification phase is to validate and document business ideas and provide sufficient basis to decide whether the business idea represents a technically and commercially viable Business case.
- Business planning; The business planning phase is to establish a feasible Investment project and to prepare the basis for the concept phase, including the concept selection criteria.
- Concept development; The objective of the concept development phase is to establish a shortlist of viable development concepts, select preferred concept (Concept Select) based on the pre-defined selection criteria and to mature the selected concept towards a FEED.
- Definition; The objective of the definition phase is to mature the Investment project to the required level for a final investment decision.
- Execution; The execution phase is to realise the Investment project by performing detail design, construction, commissioning and preparation for operations.
- Operation: Is when hand-over is accepted by the receiving business area.

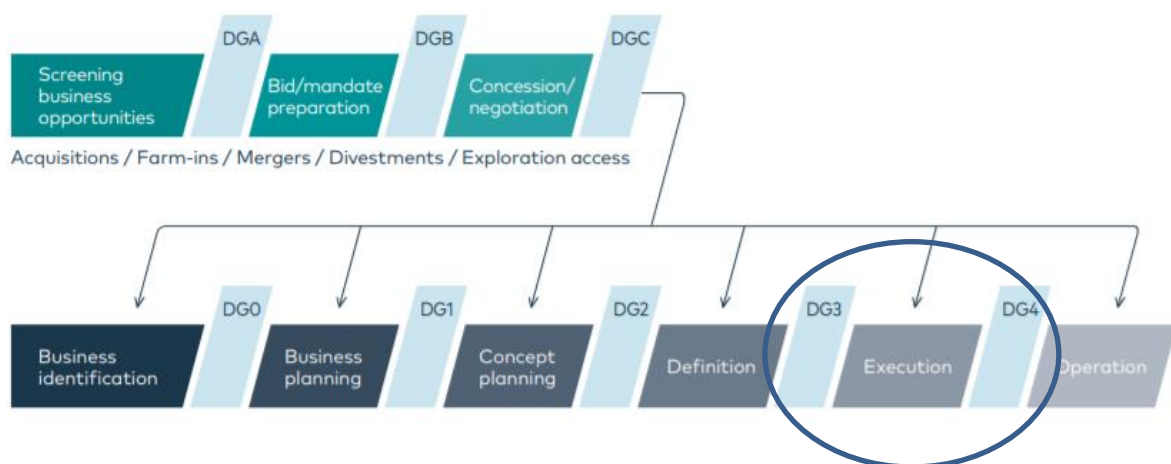


Figure 3.2 The Capital Value Process, from Equinor Book (Equinor, 2018)

3.4.1 Project Management in Equinor

The Equinor book is the core of Equinor Management system. It describes the most important requirements, it defines a common framework from the way the company work. The management is structured in 3 levels Fundamentals, requirements and recommendations. see Figure 3.5 in chapter 3.4.4 for more details.

The fundamental requirements apply without any exceptions. A Fundamental requirement document are describing the Management system function. If governance for a new asset needs to be established for the first time the project starts with the work process establish management system portfolio.

There is a work proses for management system for developing governing documentations. It governs development of governing documentation from a perspective of owner, both for

initiatives and high level of change plan and other development initiatives. When governing documentation is published with relevance, the work process for implementing governing documentations, governs how business line assesses suitability, implements the governing documentations and make it legal binding by setting validity.

3.4.2 Managing performance and risks

Within Equinor improved risk enabled performance, performance management has been focusing area for several decades. The company have developed 'Ambition to Actions' process, Equinor's management process, which runs all the way from the strategy to people, ending up in Equinor's personal performance goals tool.

"Ambition to Actions is based on the Balanced Scorecard concept, but combined with Beyond Budgeting principles it becomes an much more unique and robust management model, solving many of the problems often seen in more Balance Scorecard implementations" (Bogsnes, 2012)

The Ambition to actions start with an ambitions statement, a higher purpose, call it a vision, call it a mission. We don't care as long as it ignites and inspires, Bjarte Bogsnes says. Ambitions and strategies are translated across five perspectives: people and organisation, health safety and environmental, Operations, Market and Finance. Each strategic objective has risks, actions and indicators.

All projects establish a Project Execution Strategy including a describing the main strategic objective in the Execution phase. This include but are not limited to HSE, Design, construction and completion, Scope management, people and organisation, quality and risk management, Technology, IT and communication and Document Management. Normally a periodic analysis of the status related to e.g. cost and progress shall be performed. The analysis shall identify actual status, prognosis, and possible measures to manage the project's development. Further details regarding project performance monitoring and follow-up is described in chapter 3.5

3.4.3 Companies requirements for project execution

The Management system used in project execution is called ARIS. The company has over many years developed ARIS process model which is available to all employees and has the intention of standardizing the way people work. The processes are described in detail and have both technical requirements and guidelines.

This system exists to avoid that employees in different units have different approaches in their work, so that a work process is always familiar to all colleagues. For example, when transferring persons from one project to another it is important that the persons know where to start and how to recognizes how things are done. ARIS contains of the Equinor Value chain, Corporate framework and the Cross-value chain.

Within the Value chain we find Project development. Within DG3-DG4 we find Prepare execution and Execution. In the preparation phase the project is mobilised, kick-of meeting is executed, and execution strategy is updated. With focus on execution strategy including contract and procurement strategy. Identification of long lead items must be done in this phase. The level of quality review prior to next decision gate do be decided. If the project is a modification project requirement for scheduled shutdowns must be identified.

Management system start page > → → Execution

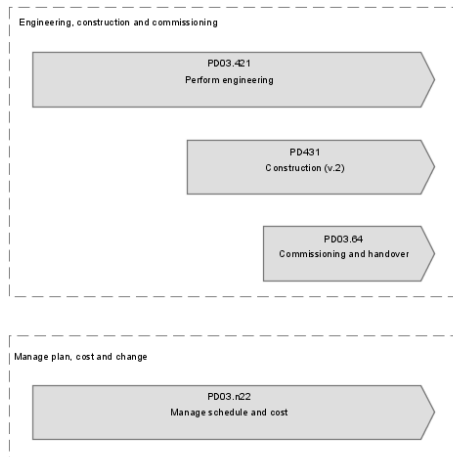


Figure 3.3 from ARIS workflow for Engineering, Construction and Commissioning

Execution strategy shall be communicated to the project owner and to all the follow-up team members in the project organisation. In the Execution Phase indicated with and circle in Figure 3.2.

Engineering, Construction and Commissioning have their own workflow see Figure 3.3. Displays that they have different starting point in the project execution phase. During the hole phase Manage plan cost and change are there to support the project and Engineering, Construction and Commissioning.

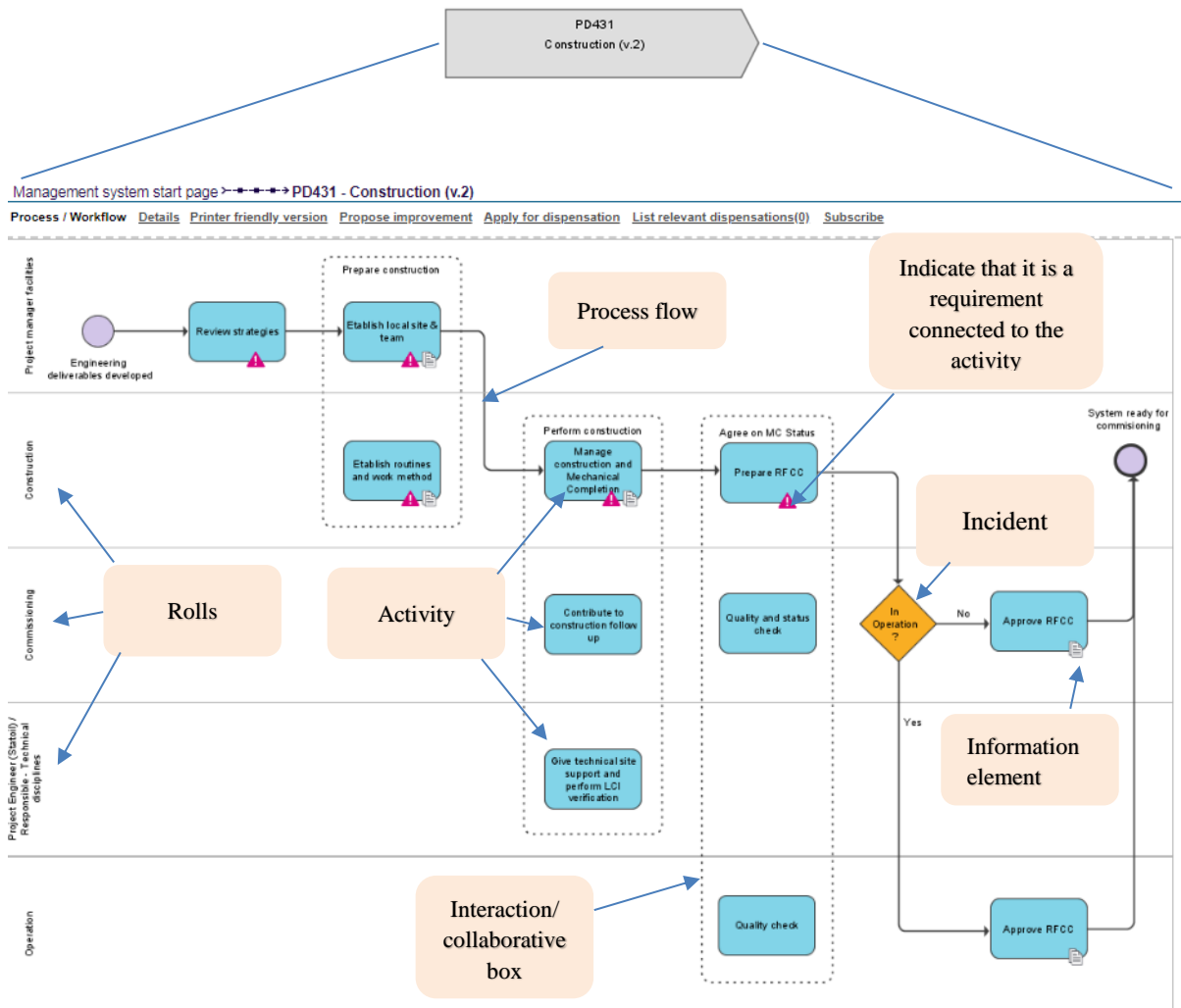


Figure 3.4 Example of a workflow in a management performance system with explanations (Source: ARIS)

Each workflow looks like Figure 3.4. The workflow 'PD 431 Construction' concretises the processes. Where the roles, responsibilities and action are clearly defined. The various steps in the process can contain both requirements and information elements, individually or in collaboration. ARIS is built with an interactive user interface where clicks on each element provide access to additional information.

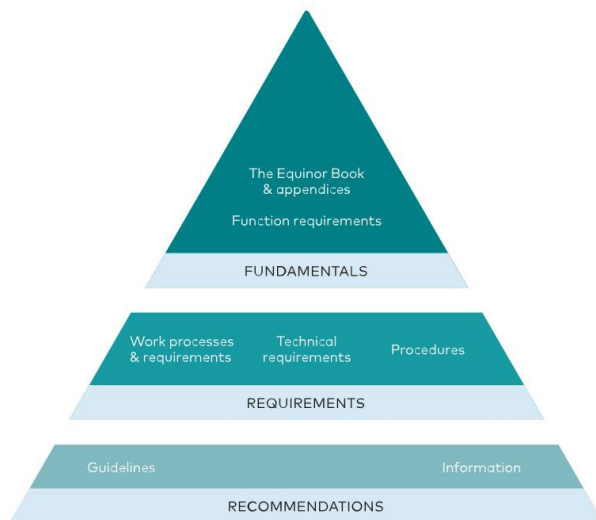
Each role is defined and the process of activities during the project execution phase is shown in Figure 3.4. Essential routines and work methods shall be described (e.g. in the site manual) and made available to all site team members. And these shall reflect the follow up strategy and the identified risk picture. The level of detail shall be evaluated and be dependent on e.g. complexity, evaluation of risk and previous knowledge of the construction site(s) / Contractor.

The Company shall verify documents, drawings in the Engineering phase, and Mechanical Completion Check records and punches as part of the completion inspections and in accordance with projects requirements. The Company or its representatives shall through inspections / verification of Contractor's/executor's work obtain the required level of confidence related to quality and workmanship for each discipline / work type.

Verifications shall be based on sufficient check of the quality of the performed work. Equipment is built and installed in accordance with relevant drawings and specifications. All specified tests and inspections are carried out and documented. The installation is ready for transfer to the Commissioning Team. The Commissioning Package is hereby ready for transfer of responsibility for preservation to Commissioning.

3.4.4 Standards and regulations

Equinor’s Management System is structured in three levels Figure 3.5, (1) fundamentals, (2) requirements, and (3) recommendations (Equinor, 2018d). All governing documents, including technical requirements (TR), regulations, guidelines (GL), functional requirements (FR), work requirements (WR), system and operation descriptions are in Docmap Equinor’s own document library.



*Management system hierarchy
Our management system is structured in three levels: fundamentals, requirements and recommendations.*

Figure 3.5 The structure of the regulatory framework from Equinor book (Equinor, 2018d)

Equinor has developed a set of standardized tools that the company use to execute different tasks in a safe, precise and efficient way. This provides consistency and enables continuous improvement.

These are Risk management, The Capital Value Process (Figure 3.2), Compliance and Leadership, Lean and Management of Change. These tools are described in the Equinor book (Equinor, 2018d)

Lean have been proven to be a successful way of working for many companies worldwide, starting with the car industry and Toyota in Japan. With inevitably changing processes, adding Lean principles to the changes in a controlled manner could help add value to even major Oil and Gas companies, e.g. due to its benefits related to time and resources.

Modig and Ålström see lean as an operation strategy, using the efficiency matrix. The matrix illustrates that lean operations strategy involves the organisation to the right in the matrix by increasing flow efficiency. (Modig.N et.el)

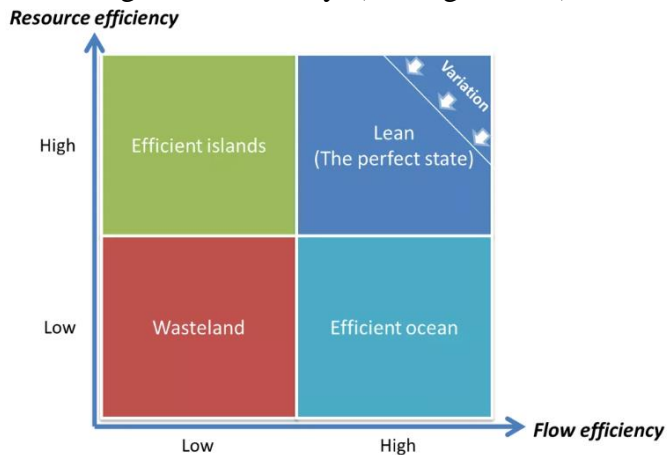


Figure 3. 6 Modig, N. & Åhlström, P. (2012) This is lean: resolving the efficiency paradox, Stockholm, Rheologica publ.

A handbook is made for best practice site safety in Project Development and are being used to secure best practice at site related to International Association of Oil and Gas Producers (IOGP) 9 Life Saving Rules in Project Development (IOGP, 2017). Equinor's clear goal is zero harm and want all people always home safely. This handbook provides an efficient tool for a proactive implementation and follow up of site safety in project development to avoid harm and injury to people.

These best practices are mandatory and to be used to ensure compliance with requirements and standards. Following these best practices could have prevented 80-90 % of the injuries in projects. IOGP's 9 Life Saving Rules are incorporated in these best practices to further strengthen site safety e.g. job preparation, safety inspections, reviews and meetings with suppliers. The safety leadership skills in this handbook describe the necessary behaviour and actions to follow these best practices towards the exposed end. Expectations for all personnel working with Equinor projects to proactively avoid incidents to happen. An Synergi Life App to report observations are introduced to the projects and this gives a good and safe way of reporting and documenting the safety culture in the project.

3.5 Risk-based project follow-up strategy.

In Oil and Gas projects the strategy is normally to prefabricate, assemble and complete as much work as possible onshore before transportation to field. Equinor are normally establishing a follow-up team at Engineering site and at the installation site. Engineering shall be executed based on results from earlier phases and on agreement. The follow-up team shall handle technical queries, Non-conformance request and Dispensations. In addition, review of drawings and documentation among other things. Technical meeting shall be held regularly with the Engineering EPC-contractor according to follow-up strategy. Technical follow-up and quality control of executor's activities and deliverables shall be performed. The level of follow-up shall be risk based. The follow-up team for construction performs quality reviews

of Contractors deliverables and monitor that they are on schedule and are delivering the right quality.

Personnel with operational knowledge shall be involved in the follow-up phase to ensure that e.g. defining of packages for commissioning and also to ensure good handover integration with Operation to optimize shut down of systems (down time). They shall also contribute to verify optimal tie-in/hook-up points and give input to optimized testing in the operational phase.

Before finalizing the scope that are possible to complete onshore shall be finalized. Typically, a list of main principle- and strategic decisions are to be concluded, here are some examples:

- Health, Safety and Environment shall be in focus at all times.
- The Project shall execute all relevant project activities to ensure start-up of the project no later than the date set forth in the baseline plan.
- Reduce offshore scope/activities by optimization of installation methods and thereby transfer of scope onshore or reduce the overall scope.
- Reduce offshore commissioning scope/activities by transferring scope to onshore sites at the maximum extent possible.

Deciding what to inspect in a project is based on what system are the most critical in the plant and need special attention. Mainly with criticality in respect to HSE, security and the environment. The inspection program is described in Equinor's technical requirements (TR). In a construction phase each equipment is only inspected/checked once, but some equipment need extra attention during storage and installation. Then a preservation team have this as their main task to establish the routines for how often equipment/systems shall be inspected and what techniques to use. Data to structure these tasks is punched in the software tool and are connected to the tag number.

3.5.1 Examples of Key Performance Indicators for the Execution phase

Normally *Key Performance Indicators (KPI)* are used to measure the performance in a project. These depends on the deliveries in each phase. For engineering e.g number of documents produced is highly relevant. For Construction, some KPIs are multidiscipline and categorised as mandatory in each project. Construction KPIs that are related to one special discipline or quality, may change in each contract depended on the Scope of Work.

Some KPI's are important in the start of the construction phase in the project, example of such KPI is, all needed installation drawings produced. Also, number of work packages with material available are important, that gives available hours to start the installation work. This give an indicator to compare against the manning in the project. Other KPIs may indicate the defect rates. These indicators indicate if there are quality issues that needs to be verified or audited.

3.5.2 Contractual incentives and monitoring

Milestones are also used to measure the performance in a project. The Milestones are described and dated in the contract. The contractor needs to inform ahead if they don't have the possibility to reach some of the milestones, and if there are external factors that make the contractor slightly delayed. The contractor can ask/send a letter for the approval of a milestone. If they believe the reason they didn't meet the date was out of their control.

Some of the milestones are critical, and if the contractor succeed to achieve this they get a bonus. If contractor fails to achieve the milestone they get a penalty. The overall monitoring at a tactical level for the project is done using Baseline. The Baseline is an accounting method used as a "budget" for the whole project period. Twice a year the baseline is updated.

The Baseline consists of all the key drivers in the project. It indicates what will happen in the project if e.g. the engineering and procurement phase is delayed, the consequences will be big with a shorter time for installation in construction phase. When looking at each element in the EPC contract; Engineering, Procurement and Construction they are quite different in nature. This implies that sometimes different incentive models are needed to secure best alignment of Company and Contractor interests, depending on the contract.

3.5.3 Contractual reporting requirements

During the project execution phase weekly and monthly reports need to be delivered from Contractor to Company. These reports are also used to measure the performance in the project. There is different requirement of what's needed in a weekly repost compare to a monthly report. An example of the content in at monthly report, which start with a summary of work accomplished during the reporting period. It gives status on HSE, established goals in the project, overall progress and cost status including forecast per work package. It contains milestone status, upcoming key activities, outstanding and new issues. Contractor shall comment in the narrative section on trend analyses of key performance indicators and deviations to agreed targets and recommend corrective actions for areas where targets are not achieved.

In the Health, safety and the environment (HSE) section Contractor shall give status on the HSE program including KPI's and activity plan. And a description of reported incidents last month and implemented preventive/corrective actions and lessons learned from the incidents. The reports shall also have a status for audit and examination program. And a Top 10 risk list and the most important actions top 10 risk, ongoing activities, critical path and key milestones etc. The information in the reposts are manually prepared and presented in monthly meetings. Most of the information that is made in the reports are available digitally from several software tools and are transfer to company in accordance with Figure 3.8.

3.5.4 What Performance Dashboards are used in Equinor projects today?

In addition to the reports given from the contractor, the follow-up team make their own monitoring reports, of the activities done by the follow-up team. This is shown in reports, located at a shared area. Some of these are produced manually, some semi-manually with some degree of automation.

Since the status reporting are a collection of data from different data sources and are updated each week. It required professionals that have a multidisciplinary understanding of the project phases and challenges that are critical in each phase of the project. There for resources used for producing these performance status overview is often highly qualified personnel wanted in many different projects. The time used to produce this performance status are not easy to estimate. The data and information on these performance dashboards is “history” when the dashboard is produced, since the information on the dashboards changes all the time, because of the amount of personnel working in a project. There is also a risk that quality of the data may be poor when the overview is made manually. It looks like most of the KPIs and measurement are standardized, but since the data are not automated it makes it harder to evaluate the outcome, benchmark to other project and secure better focus and decisions. Figure 3.7 and Figure 3.8 are examples of typical performance dashboards used in projects today, these indicates different approach to what to monito and how to present the status.

Both are easy to understand, and it gives a quick indication of the status. When looking into Figure 3.7 you see most green, and some yellow indication that the deliveries are behind target but have no impact on the fabrication/installation. Witch indicates a good and “healthy” project. But it will always be an uncertainty when the status is produced manually, is it adequately presented or are there any filters, delays or reported too much, when the input is manual that makes uncertainties in the project.

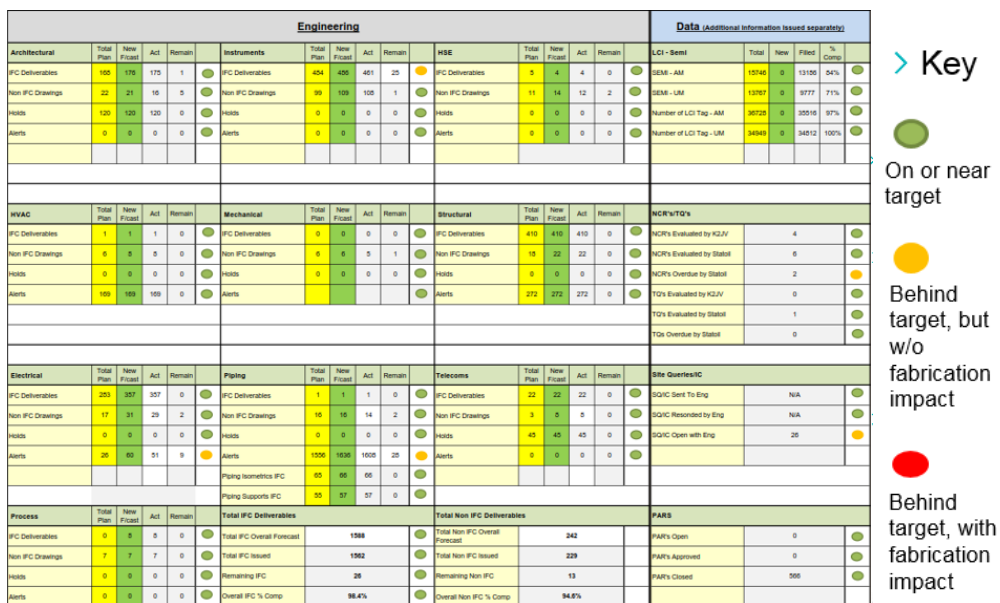


Figure 3.7 Example of performance dashboards used in one of the projects

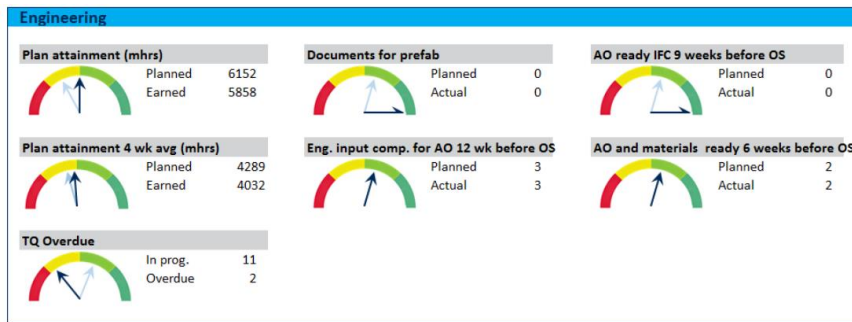


Figure 3.8 Example of performance dashboards used in one of the projects

Figure 3,8 is easy to understand, and it gives a quick indication of the status. But since it is manually produces, the same questions will be asked when looking into since error may accrue. The layout gives indication of planned versus earned or actual. And the arrow indicates with the light blue the planned and the dark blue indicate earned or actual. Important data that all project members uses and takes time to produce.

3.5.5 Data collaboration in a project

The Oil and Gas industry have a long history of sharing data for industry-wide improvement of safety standards. This culture can be further leveraged in the digital age by increasing the flow of information across the industry and by developing benchmarks for both safety and performance. If the follow-up team or contractor wants to have today's status in the project execution phase, the personnel in the project organisations need to have some degree of detailed knowledge of the software tool/source system to all systems shown on Figure 3.9 and need to produce the reports them self.

In large project the construction hours per week may be from twenty to sixty thousand hours each week, so a report made early in the week is not beneficial enough, when it comes to planning of new activities/changes or rework. Then new reports are made manually several times during the week by most of the follow-up team, to get information of the latest status.

The data transfer information from other business, like contracts and suppliers are basically standardised. But each time a new contract is awarded Company and Contractor needs to align the data flow in accordance with Figure 3.9. To be able to align the software often special resources within the different companies are required, that have experience from earlier projects.

The regulations in the contract cover most of the details. There are several software solutions that supports engineering and operational phases in order to streamline the workflows and processes so that plant engineers and owner operators will enjoy the benefits of enhanced productivity and quality. An example of an overview of how several software tools shares data during the execution phase is shown in Life Circle Information (LCI) System Architecture (Figure 3.9).

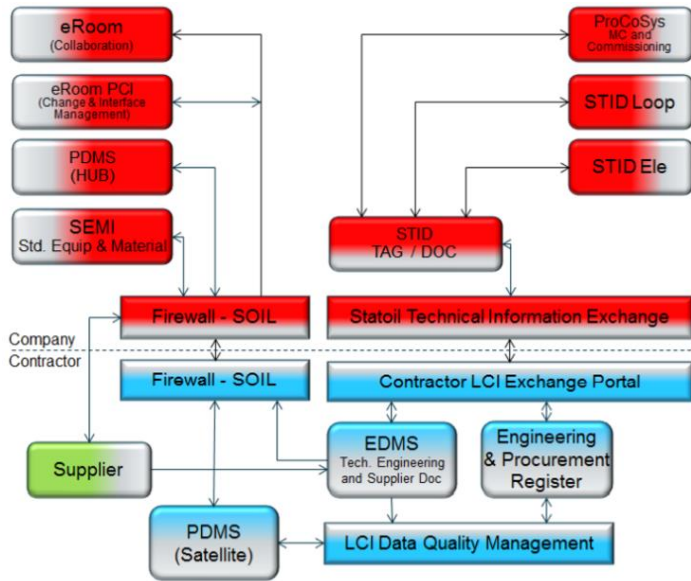


Figure 3.9 LCI System Architecture in a project

To secure data quality there is a filter between the Technical Information Exchange and the software on company side. In every data transfer an automatically check is done to evaluate that the data transfer is containing data that are in line with the technical requirements. This ensure that the data are secure and reliable which is a good foundation to use for making automated performance dashboards.

3.5.6 Organisation in project execution phase

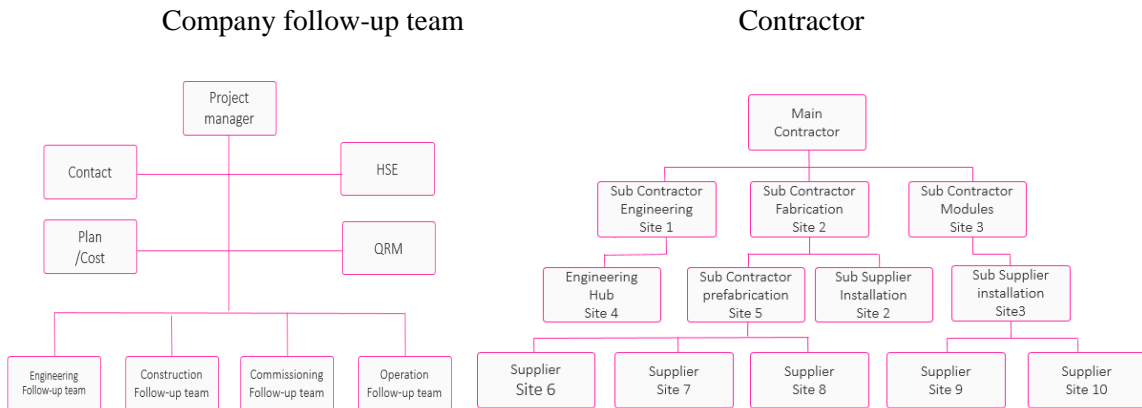


Figure 3.10 Typical organisation for company and contractor in project execution phase

Figure 3.10 is representing a typical organisation chart for a project in the Oil and Gas industry. The company project is normally organised in a project responsible division under the Company/Business. The project organisation is responsible for the main contractor and are following-up the delivery. The project team for the company consists of approximately twenty to forty persons when starting up in the execution phase, but the follow -up team will grow and be over two hundred the commissioning and handover phase.

In the Contractors organisation there are much more depends on the size of the projects. In addition to the project organisation, several responsible persons in the Company and contractor organisation including Partners are interesting in the status overview. Normally the project team have the same sites as main contractor. But often some of the sub-contractors has a big scope and then the Company's Project follow-up team needs to be present on these sites for executing the activities. The project follow-up team are also visiting all the sites to ensure good quality and delivery. This may cause challenges related to time and software issues. An automated performance dashboard with real-time data would be beneficial, related to the challenges of having several sites and large organisations. Not just for Company but for the contractor, sub-contractors too.

Involvement of stakeholders are very important in the Equinor project execution, to assess value, risk and need for change. The requirements are only to assess the need to involve stakeholders. In order to drive efficiency for the task being performed, a recommendation is to use the templates and methods described in the requirements. In a project execution phase there are several stakeholders as shown on the organisation charts. Project manager have the responsibility in cooperation with project provider and project members to create and update a stakeholder list and identify internal and external stakeholders based on risk picture. This can be contractors, suppliers and industry organisations. There are Business owner and different Business partners owning a percentage of the project. Sharing both the risks and opportunities in the project and they are of course interested in the project status and performance.

4. Analysis and improvements ideas

This chapter analyses findings from interviews, workshops and written documentation collected in connection with this Thesis. Most of the informants are professionals from Equinor, mainly with profession within Engineering, Construction, Commissioning and information technology.

There are several digitalization programmes in Equinor, as indicated on the roadmap. One of them are commercial insights by improving analytical tools and data accessibility within our commercial areas to enable better decision-making. Several initiatives will come from this programme. For this Thesis it was chosen to study a phase of the project where the activity and resources are high to search for improvement ideas in connection with digitization.

As indicated earlier in this Thesis there is an internal digitalization project initiative ongoing in Equinor, this initiative is still in the design phase. Therefore, the second phase related to design, execution and continuous will be described with several assumptions. There for some of the recommendations in chapter five will probably be performed in design and execution phase.

During this digitalization project workshops were held with other companies and with other personnel working with digital initiatives in Equinor. They have shared knowledge and experiences that are used in the analyses. A potential weakness of the data is a limited selection of projects, which can hardly cover the diversity of issues associated with digitalization of dashboards in the Oil and Gas Industri.

A common feature of all digitization initiatives is to improve work processes related to organization, process and technology. Improvement of work processes is only possible through the proper alignment of all these (Saputelli et al., 2013).

In this chapter several improvements ideas will be presented, this indicate the process that digitalization projects are facing when introduced to several possibilities for utilising the data in a better way.

One of the deliveries in the digitalization initiative are *developing dashboards in the execution phase*.

This case will be the analysing part of this Thesis.

Figure 4.1 are developed from Figure 3 in the survey report *Best practices and lessons learned after ten years of digital oilfield implementations* (Saputelli et al., 2013).

The listing inside Figure 4.1 are *main tasks* that are identified by the dashboard design project. A description of all the main tasks inside the phase and the *deliveries*, which is indicated with an *arrow under* the phase will be described.

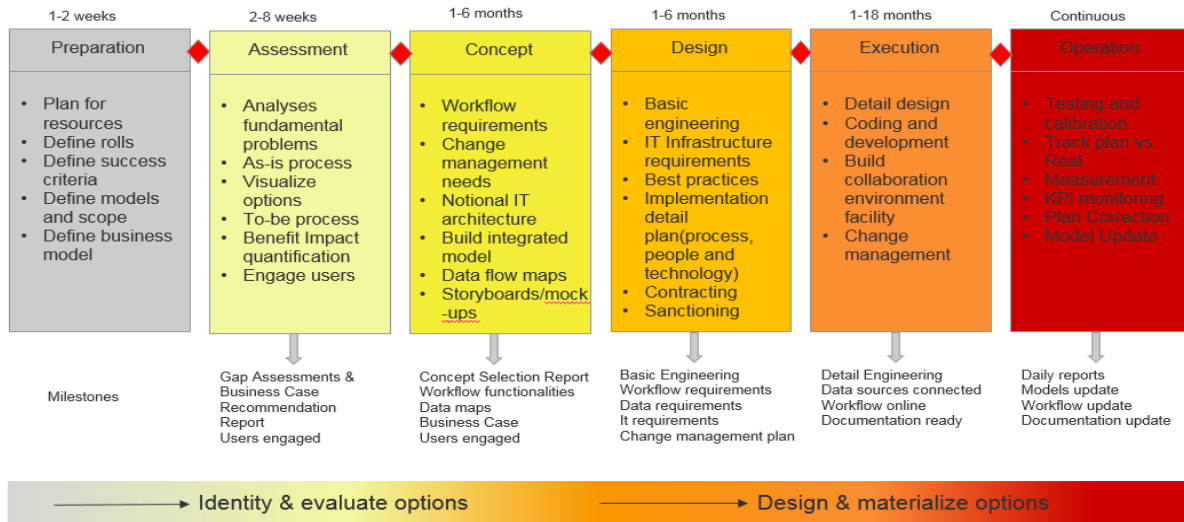


Figure 4.1 is Developed on the same layout as source: Figure 3 DOF project implementation phased approach (Saputelli et al., 2013)

Starting with *first phase* to identify and evaluate options by do the necessary *preparations, assessments,* and choose a *concept*. Second phase is the *design, execution and operation*.

4.1 Preparation phase

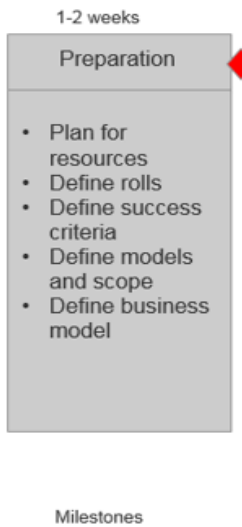


Figure 4.2 part of figure 4.1

In the preparation phase recourses was identified, and rolls and responsibility were decided with in the team. The digitalization team consist of both end-users and IT designers. Documents was produced to describe the Purpose of the project, business case, steering parameters, stop criteria for the project, framework affecting the project, risk picture, project execution requirements, overall milestones and project financing and cost.

When defining models and scope some concern and needs were mention;

- It is a risk that the decision basis being used in the projects are outdated.
- There is an inconsistent use of KPIs across the ongoing projects.
- Varying use of project standard work routines and best practice, with manual and complex routines.
- Information silos across several application software

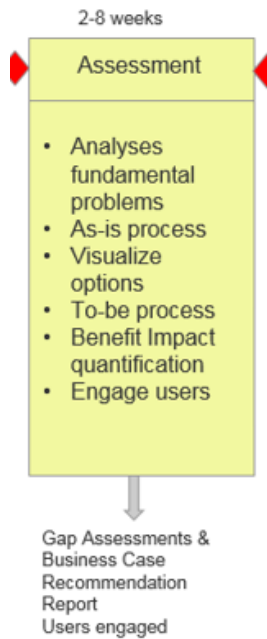
The success criteria for these concerns are an ambition to deliver simplification and improvements by a proactive use of leading key indicators and live information, simplifications and standard processes.

The project performance dashboards will be developed with some long-term ambition:

- One common area for all key project information
- Create a modern performance system for projects for easy access to updated information.
- Easier to find understand, get control and know what to prioritize
- Help new staff starting in the project to easily understand their tasks
- Increased administration efficiency and less manually reporting
- Live collaboration between field and office(s) etc.
- Possibility to present information to stakeholders on dashboards with real-time data.
- Standardized approach across projects, less dependent on individuals
- Common understanding of a project's current situation across all projects
- Uniform and visible KPIs across the entire project portfolio
- A solution that is affordable and fast to launch for any new project
- Easy and faster start-up and organization of projects
- Possibility for the users to drill down based by roles
- Standard way of sharing information between company, suppliers and contractors.
- Possibility for structured follow-up of actions from meetings, reviews etc.
- Easy way to present KPIs and performance status for the projects

Delivery (Figure 4.4): Milestones was defined in the internal digitalization project initiative. The milestone was in accordance with the deliveries on Figure 4.1, first milestone, date for finalizing the preparation phase, second was finalising assessment phase according to dates given in the milestone phase. All deliveries on the Figure 4 have a delivery date in the milestone plan.

4.2 Assessment phase



Understanding the project needs and expectations it is important, when analysing fundamental problems

The As-is workflows process was examined to see what kind of improvements and data that were needed to give a visualization of the project status and performance.

Identifying the biggest issues when it comes to effective project execution and follow-up, has been discussed in the workshops and meetings with several stakeholders including end-users.

Current performance dashboards and reports studied and presented in chapter three, indicate that these data and reporting for the project status and measurement is normally given in report form company or contractor (As-is). As-is and To-be is visualised in Figure 4.4. and findings in Table 4.1. New opportunities to utilize Data/app based platforms while following-up the design, equipment and installations in the execution phase.

Figure 4.3 part of figure 4.1

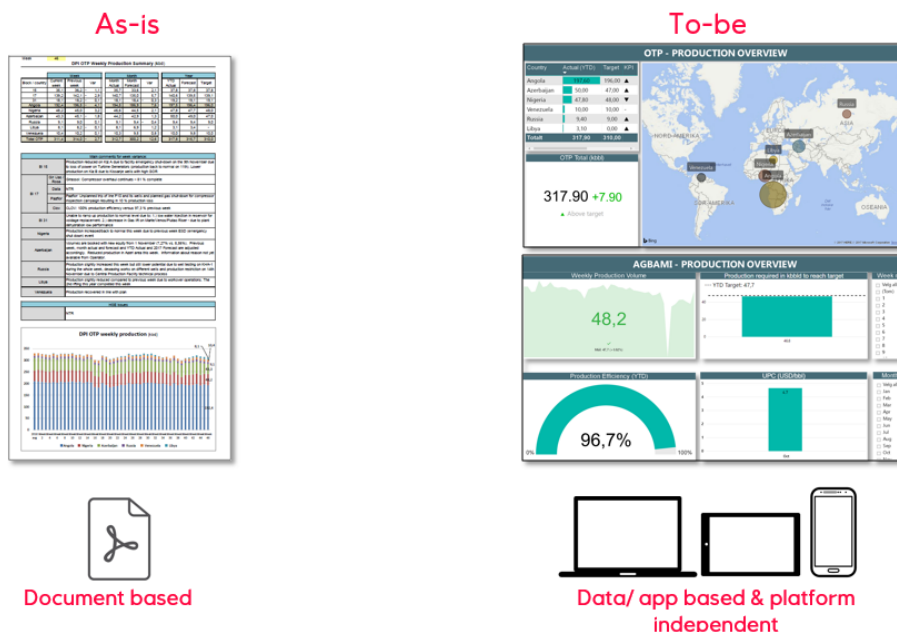


Figure 4.4 Source: Internal Equinor presentation

Looking into ongoing project in Equinor, an example from one project is that there is a total of 14 different documents that need to be open and evaluated to be able get the status of the project. This is time consuming and not an efficient way of working.

Table 4.1 is listing fundamental problems to the as-is phase (What will improve), given by follow-up teams from the execution phase. Indicating that to-be (What must happen to see progress) With an improvement idea (How can we make this happen)

What will improve?	What must happen to see progress?	How can we make this happen?
<i>What is going to be faster, cheaper, more effective, or use less resources?</i>	<i>What is going to change or be implemented to realise the improvements?</i>	<i>What will be done to ensure that the changes are realised?</i>
Standardised visualisations and measurements across projects save reporting time and make it easy to move between projects	- Standard layout, KPI selection and visualisation is set up in selected tool - All projects use Dashboard for follow-up of project execution across portfolio in a uniform way	- Gather the right competence and capacity in the project team. Dedicate expert and advisors to assist in development, testing and implementation. Important data to be collected and identified. - Update requirements and best practice documents to include the use Dynamic Dashboards for follow-up of KPI's etc.
User- friendly visualisations that focus on key questions for top level and highlight problem areas	Ensure right support to new project in order to set up interfaces and systems in to utilise new Dynamic Dashboards	Create implementation package for projects Run a road trip to all ongoing project where it can be beneficial to take use of Dynamic Dashboard solutions and assist ongoing projects to get started
Less time spent on handling data from contractors	Contractors report raw data that can be processed automatically	Create contract input needed to utilise solution to full extent
Better fact base for decision support	Dashboard identifies problem areas automatically and reduces time spent on writing and reading reports about non-critical status	Make detailed experience data available to new projects - be part of the database
Problems caused by project delays are identified and mitigated early	Reports made manually today will be updated automatically	Knowing earlier which tasks need to be done in the near future – better time for planning – and reschedule priorities
Improved safety awareness	Synergi use and follow-up is visualised to show weaknesses in SSU follow-up, e.g. age of open cases Teams are motivated to close cases and supported in prioritising cases	Integrate SSU details in standard dashboard setup
Growth and rework is reduced	Projects are prepared for expected growth	Readily available knowledge about delays enables early adjustment of plans
Less time spent on identifying problem areas - increased focus on the actual problems and faster resolution	Everybody has the same updated numbers Clear identification of problem areas in dashboard	Total summary overview of project status is continuously available. Better meeting management We are talking about the same numbers Same number with contractor and customer access for both

Table 4.1 Examination of fundamental problems and how to ensure change.

The project execution phase is a complex related to different needs in different between Engineering, Construction and commissioning. Therefore it is important that the performance dashboard is dynamic. Like an interactive system that dynamically updates its views based on the user's choices and allow the user to immediately perform its own analysis. It automatically updates e.g. when the project goes from one phase to the next. The construction of dynamic Dashboard is built on the same principles as the process of a project. Different building blocks that needs to fit together and different actions and decisions that needs to be done in the right sequence.

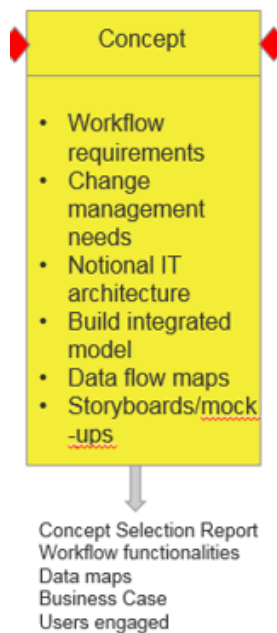
Establishment of a data and information platform is the basis of the dynamic dashboard. Using the real-time data of indicators that the follow-up team can directly observe the progress and challenges. Giving information more accurately and predict the changes in the near future, to improve the yield and effective management of the project, to achieve optimization management in various levels.

This will reduce the time spent on finding information. And aim to help the different areas of responsibility / role-holders to understand each other's status and challenges.

The deliveries in assessment phase (Figure 4.8) Is a gap assessment and business case, and a recommendation report was issued based on input from team members and end-users. Some of the visualize options that are used in the industry today, indicate that there are a lot of information that needs to be on a To-be dashboard. That's why the recommendation report also need to consider the characteristics of well-designed dashboards and some of the common mistakes that can be done when developing dashboards.

4.3 Concept phase

1-6 months



Entering the Concept, the main tasks are listed in Figure 4.5 Workflow reequipment, notional IT architecture, build integrated model and data flow maps are described in chapter 4.3.1.

To be able to describe how performance dashboards could be designed we experienced that a storyboard (Figure 4.10) was useful. First, we were afraid that the storyboard should reduce the creativities among the IT designers, but now we see that the storyboard helps the digitalization team and designers to understand what we will produce and how it can be designed. This is a storyboard and the final result will not look like this.

Figure 4.5 part of figure 4.1

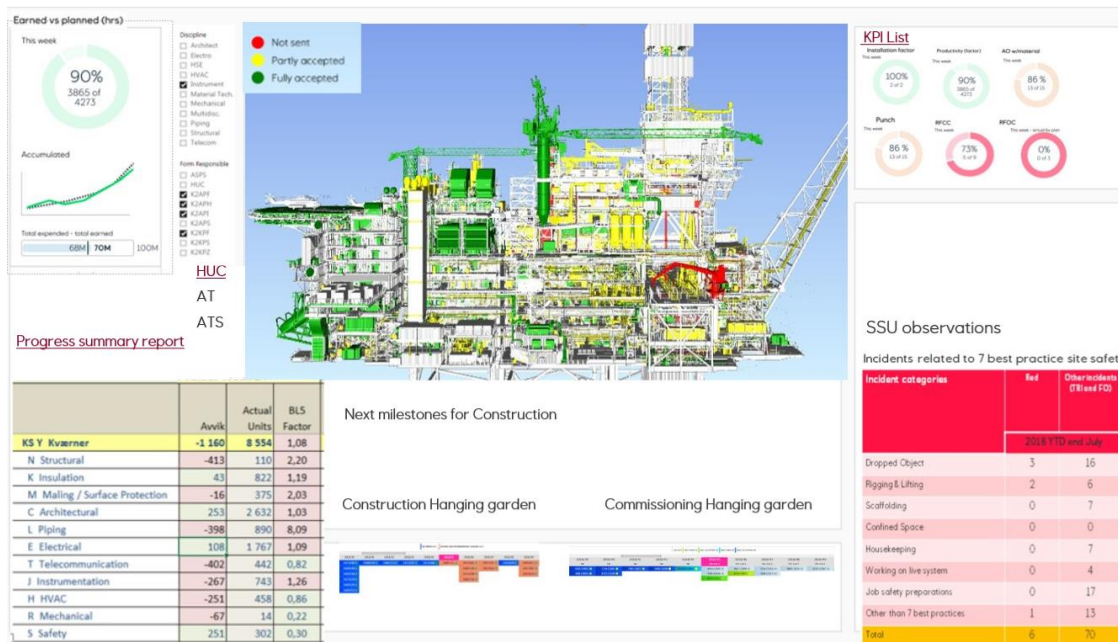


Figure 4.6 Storyboard used for the development of dashboard

During the develop of the performance dashboard for project execution we have examined how these are designed earlier in the ongoing projects.

The data that are visualized on the storyboard for project execution is listed in Table 4.2 below. This list indicates the status that are needed in the execution phase. All priority one and two are shown on the storyboard (Figure 4.10). Why these are chosen is described in table 4.2.

Priority	Items	Questions to answer	Actions to take
1	HSE (SSU observations)	Is our safety culture good enough? Which underlying causes are our largest problem?	Are we working with SSU the way we want to?
1	3D model (Scope)	To be able to make better understanding of the scope of work (SOW) a 3D model of the project, gives a visual picture of the maturity of the design.	Each Tag has a status chain that indicate if the object is "frozen" and all documentation are received and updated.
1	Contractor Progress (Earned vs planned)	Are we ahead, on target or behind? Do we have a problem? Is the contractor planning with sufficient resources to complete the tasks?	Revise plans, add more resources to problem areas
1	KPI management	Identify problem areas, any gaps?	Evaluate the consequences
1	Engineering, Construction and Commissioning KPI	Identify problem areas, any gaps?	Drill down in KPIs, identify causes, assign actions...
2	Construction progress summary report and Hanging garden	Does contractor have any issues e.g. missing material, rework, no go area, hook-up scope for not handing over the MC/ Compack in time?	Evaluate the consequences and discuss further actions with contractor. Need for more recourses Challenge delivery times or supplier etc.?
2	Commissioning progress Hanging garden	Are we ahead, on target or behind? Do we have a problem if we are falling behind?	Evaluate the consequence and/or adjust commissioning plans
2	Milestones	All critical packages are linked to the milestones In ProCoSys/ Safran	What milestone are outstanding? Which milestones will probably not be met?
3	Quality deviation	Quality deviation list or input from earlier projects	In different software for each project, and informed to new or ongoing projects via experience transfer
3	Risk Management	Any critical Risks coming up, or not handled correctly?	Do construction have any risks that will affect the performance and progress?
3	Assistance to site (ATS)	Which suppliers are mobilized on the project at the time	Which suppliers are doing well? Anyone behind schedule?
3	Work permit (AT/WP) for commissioning	Risks during construction	Are there areas that are not available for construction due to commissioning activities?

Table 4.2 Priority list of the status that are needed in the execution phase

Risk management activity is very important in the follow-up team. The reason this have priority three in the list are because the application software used for risk management is well known in the Oil and Gas industry. The software has its own dashboard presenting top ten risk visually.

Work permit (AT/WP) for commissioning is rated low since there is an ongoing initiative to improve these activities, and this will be in cooperated to the dashboards when its finalized.

4.3.1 Workflow and data

The digitalization project will continually be utilising a lean approach when looking into the workflow requirements. To be able to search for improvements of the workflows and tasks in the projects. It is important to examine the workflows requirements and guidelines to ensure that the improvements are in line with the requirements. This may lead to updating of the existing workflow or even updating of some of the guidelines and requirements.

In this phase of the development of performance dashboards, an integrated model/IT architecture was built to describe the challenges with many different data and applications, and the connection from the applications to the workflows. Figure 4.7 gives a better understanding for all involved personnel working with in the digitalization project and for all stakeholders that will be involved later in the implementation process. The figure 4.7 are developed based on a figure in survey report *Best practices and lessons learned after ten years of digital oilfield implementations* (Saputelli et al., 2013). It displays all the affected workflows and data systems that are used in a project in the execution phase.

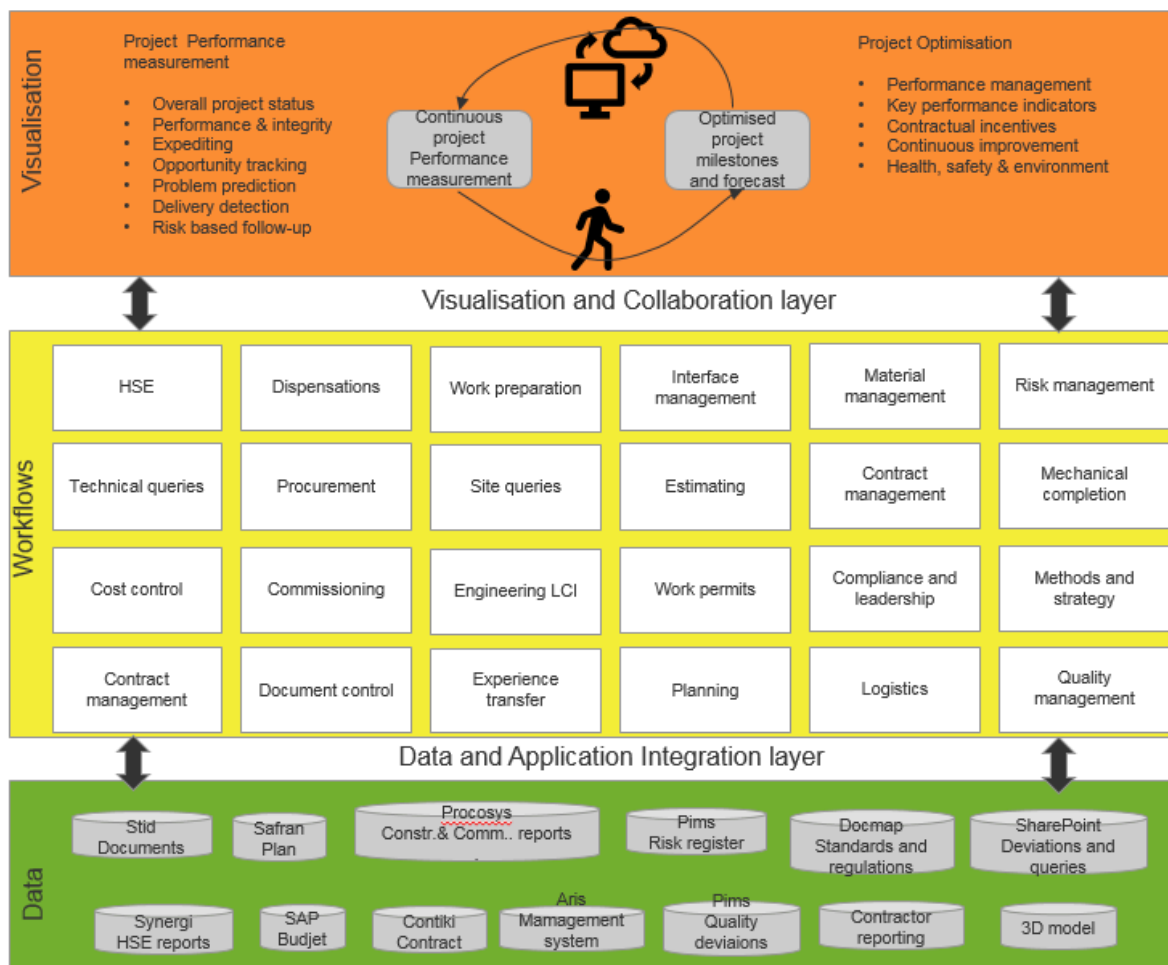


Figure 4. 7 Developed on the same layout as source, Figure 5 - DOF IT reference architecture (Saputelli et al., 2013)

Table 4.3 list the software application is used on the storyboard this indicates that there are several application programs that needs to be aligned to be able to see the overall picture of the status and performance in a project.

The listed *Items* in the table below are the same items shown on the storyboard Figure 4.6, but with further information related to where it exists (data source) and how it is reported.

Priority	Items	Data applicatio	Reported today	Description
1	HSE (SSU observations)	Synergi Life	HSE for the project are in the weekly and monthly report from contractor.	SSU visibility to ensure safety awareness and culture
1	3D model (Scope)	Navis works	Navis status are in the weekly and monthly report from contractor.	An overview of the project, that shows where there are activities related to safety, testing and availability
1	Contractor Progress (Earned vs planned)	Safran	Information are in the weekly report from Company	Gives an overview per discipline on the hours earned versus planned
1	KPI management	ProCoSys	Some of the KPI's are listed in the weekly and monthly report from contractor and some are listed in Companies weekly report.	Mandatory KPIs for all projects
1	Engineering, Construction and Commissioning KPI	ProCoSys / other	Same area sa KPI management	Choose between KPIs that are most relevant for the specific project
2	Construction progress summ. report and Hanging garden	ProCoSys / other	Same area sa KPI management	Quick overview of the situation related to availability of material and work packages
2	Commissioning progress Hanging garden	ProCoSys	Information are in the weekly report from Company	Quick overview of system handover to commissioning and operation
2	Milestones	ProCoSys/	Listed in the contract	Status overview of the milestones that are defined in the contract of the project
3	Quality deviation	From engineering/ Contractor/ observations	In different applications software for each project, and informed to new or ongoing projects via experience transfer	Quick overview of where there are Quality deviations
3	Risk Management	Pims Risk	Information are in the Monthly Project control report from Company	Link the risk in the construction phase directly to the data that are visualized
3	ATS	Safran	Information are in the weekly and monthly report from contractor if asked for.	Assistant to site (ATS) overview
3	Work permit (AT/WP) for commissioning	Input from contractor/	In manually updated lists that are informed to stakeholders in daily meetings	Arbeids tilatelse/ Permit to Work combining digital Permit to Work, Risk Assessments and Isolation Management with external systems

Table 4.3 Priority list of the status that are needed in the execution phase with data application.

All the workflow functionalities, data maps and first storyboard illustrated in chapter 4.3 and 4.3.1 are the deliveries in this phase. Described in the concept selection report and business case.

4.4 Basic design phase



Figure 4.8 part of figure 4.1

The basic engineering of some of the KPIs listed in Tabell 4.3 are designed, and the IT infrastructure for the data collection of these KPIs are within the company. That will make it easier to design. Further design will be done in this phase to indicate where the data comes from and develop the needed infrastructure.

To be able to present some of the data that shall be on the dashboard, a limited selection of what is reported now is listed in Tabell 4.3. This list is simplified, to be able to present some data used in projects in this Thesis. As described earlier the dashboards are manly one-screen that gives you an overall status. There will be one dashboard for Engineering, one dashboard for Construction and one dashboard for Commissioning. This means that it is essential to prioritise the most important information on the screen. The data in figure 4.3 are in line with performance measurements, KPI's etc, normally used in project execution like HSE, scope, planning and quality.

A priority list describes what is essential information in the execution phase in the project, that need to be designed on the pilot dashboard before release.

Each project utilising the dashboards need to ensure that the data transfer routines are establish with real-time data on the dashboards. Templates will be made to make this exercise easy and standardised for the projects to have an easier and faster start-up.

The deliveries for Figure 4.8 is ongoing in the internal digitalization project. Basic engineering will be the delivery in this phase, including requirements for workflows, IT and Data requirements. When re-examine the flow of information, it is not just the technology but also through people that needs to be evaluated (Crockett, 2009). A Change management plan shall also be prepared. This is an important plan since change management perhaps is the most challenging and important part. It covers most aspects of the organisation (Saputelli et al., 2013)

4.5 Execution phase



In the detail design phase, some main principle needs to be decided.

In addition to the application software alignment an assurance on data quality is important. The challenges to insufficient data quality needs to be shown to the user and is recommended to be a standard symbol on the dashboards. Technology and quality are two of several variables for the project management performance in the execution phase (Chen, 2015)

Figure 4.9 part of figure 4.1

In this phase a decision of whether the dashboard shall be a semi or fully automated process. The core of the dynamic dashboard is to change the work process of the project execution phase. Changing the information and data into a real-time parallel processing, and the use of real-time data streams, combined with application software of innovative and high-speed computer systems, that updates the visualisation on the dashboard when the data either are not valid any longer or if the data have changed dramatically with respect to targets and expected value. This makes the dashboard dynamic. Further study of advanced data analytics, by improving our understanding of extensive and complex data for better decision-making by means of advanced data analytics and machine learning needs to be done to get optimal use of the data available.

Although it may be good to get AI introduced, there may be some pitfalls that should consider in the process. In the quarterly report from McKinsey some indications of how to avoid the pitfalls is presented. These are related to decisions, involvement from CEO and the broad, engage end users, sharing data, data security, multi-disciplinary teams (Bughin, 2018).

The delivery (Figure 4.9) in this phase are detail engineering, data sources connected, workflow online and documentation ready. In the documentation needs to cover all aspects of validation and assumptions that has been done in this phase, to be able to have a good evaluating process during the test and operation phase.

4.6 Operation phase



The analyses of the data presented on the dashboard, has been done based on the as-is state. Priority one in Tabell 4.3 needs to be finalized before the dashboard goes live. When and what of kind of item listed as priority two and three will be evaluated after the testing and calibration period. The plan is to start with a pilot using data from one or two projects. When and which project to introduce the pilot, dashboards needs to be agreed.

Feedback from the projects must be updated and improved before further roll out. In this phase, a support team are establishing to manage the questions and improvement suggestion, with personnel involved in the development together with the professional leader in the company. Status meeting must be held to ensure the right progress in accordance to plan. Correction and prioritisations to the plan needs to be evaluated by support team.

The dashboard will be designed with possibility to measure the use/ “clicks” on the dashboards. Indicators for the use, continually be will be evaluated to secure implementation.

Figure 4.10 part of figure 4.1

The dashboard needs to be easy to understand for the user. And designed to achieve a high rate of visual perception. (IBCS, 2017). A checklist was made in one of the workshops to ensure good quality before first pilot of the dashboard. This list will be checked during the phases and when the dashboards are designed and tested;

- a web based visual graphical interface containing risk analysis data
- a system that updates automatically when the project goes from one phase to the next
- a overview of barrier and deviation status and development
- a system reducing the efforts and knowledge required to gather data from different sources
- a system automatically harvesting and presenting updated
- data (from our existing work tools)
- graphics as basis for showing data
- a system having risk indicators, smart agents and tools to follow development
- a system requiring minimum resources for operation/maintenance
- a system which is intuitive/easy to use
- a system using latest tools, technology and knowhow

Daily reports, models update of “bugs” and errors, workflow update, and documentation update are the deliveries in this phase. In this phase some of the additional recommendations listed in chapter 5 also needs to be evaluated.

As mention earlier the internal digitalization project initiative ongoing in Equinor are in the concept phase. During these phases several workflows will be examine and further developed. The some recommendation for the nest step of developing performance dashboards will be listed in next chapter.

5. Recommendations

Based on the study there are some recommendations that are listed in this chapter to ensure that these issues have the right focus when the performance dashboards are produced and when it shall be introduced to the ongoing projects.

Involvement of end-users in the development phase

To ensure that the digitalization initiatives succeed in the ongoing projects is important to involve the end-users. An experience from the ongoing initiative is that the designers with professional IT and visualisation, needs to be in the involved early and the end-users must specify the information needed for the design. This design has go in a loop until it is tested and qualified to be introduced to the ongoing projects.

Technology challenges

There are several technology challenges to get a more robust solution for the future. Some of these are:

- Data quality – ensure that all project has the right setup
- Areas of collaboration – especially between contractors and suppliers
- Reliability of systems – speed of the tool
- Data security and ownership – to avoid discrepancy and inconsistency

Ensure alignment to standards and documentation

To be able to evaluate the improvement of performance dashboard, a description of best practice must be made. When doing internal audits this will confirm or results in findings. When having a god documented work process it is easy to update an improve when new opportunities to work smarter (new and easier software, apps etc.) appear.

Also evaluate Smart workflows in this process by incorporate a lean approach in the project management process.

Involve stakeholders

When introducing a new project performance dashboard, it is important to involve stakeholders to ensure that the improvement and changes will have the right focus and the right outcome. The stakeholders need to be involved all the way through the implementation of the improvements opportunities. Project managers need to motivate users to change the way they work and avoid using old tools and processes.

Implementation,

In the Performance dashboard book, Eckerson have listed some success factors for implementing dashboards success fully. These key factors are (1) get proper sponsorship and resources for the project (2) create the right metrics and standardize their meaning (3) design a compelling graphical interphase and (4) plan ahead to ensure end-user adoption and drive the organisational change (Eckerson, 2010)

Continuous improvement

The new way of working with using real-time data on dashboards overview will have a large impact on the end-users in all ongoing projects internal and external, since it will impose a new way of working. Continue to have the lean approach when deciding what and how to improve. To be able to have an overview of all the initiatives that will come from the digitalization initiative, a recommendation is to have some input criteria. And establish a support team early in the process handling all new aspects that comes from the end users. This will help to sort out the priority of the digitalization initiative for further evaluation.

Integration and verification

To be sure that the new possibilities has been integrated in the projects, the need for a systematic quality assurance is highly needed. How to implement an interaction without disrupting the performance (Kaplan & Norton, 2006) needs to further developed between the dashboard team and the project follow-up team. The impact of integration management especially in the construction project management performance needs to be evaluated. This impact have not been studied in the literature that proposes construction specific components for integration management and analyses the relationship between integration and project management performance (Demirkesen & Ozorhon, 2017) Revealing this relationship while introducing this interaction must be done carefully.

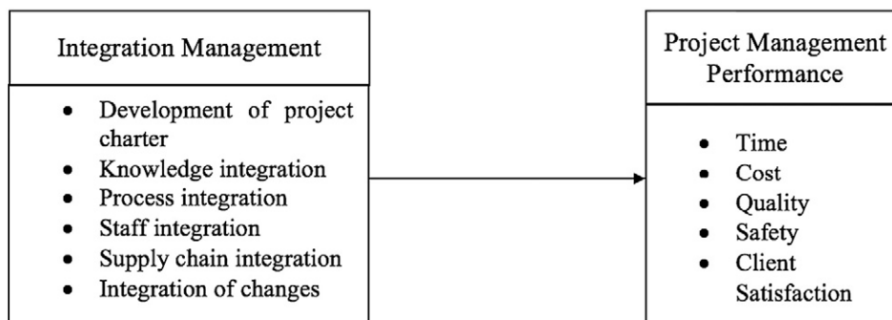


Figure 5.1 Link between integration management and project management performance (Demirkesen & Ozorhon, 2017)

The findings from this study indicates that integration management has a considerable impact on project management performance, it is suggested that this link is of considerable strength. When past studies are examined for the exposition of this link, it is indicated that there is a gap in the literature and the impact of integration management needs special emphasis. This study demonstrates the core component of integration management with its construction specific components and clearly visualizes the strong tie between integration and performance (Demirkesen & Ozorhon, 2017).

6. Discussion

In this part of this Thesis the discussion of the assignment is presented. This discussion includes the extent to whether the problem and purpose of the assignment were met. Firstly, a discussion is presented on the extent to which the main goals and objectives have been met and how. Further in the chapter, it is briefly presented general challenges I have encountered along the way and what I have learned during the work of the assignment.

Based on the size of the theme in relation to this Thesis time, it was necessary to make certain limitations during the work on the tasks itself. This was especially within the digitalization initiatives in the Oil and Gas Industry. Starting with an introduction to the buzzword of the digitalization to get an overview of that the new opportunities within digitisation are. And search for opportunities related to the projects development.

New insights and revelations on digitalization initiatives from articles, survey reports, and real-life examples has been published during the work period with the master. Several new indicatives are coming, some ongoing, and several are finalized in Equinor. The more research and analysis I did about digitalization, it looked like that digital initiatives may initiate fundamental changes to the business and projects environment. Innovative technologies that emerges in the digital environment will probably initiate changes to a lot more that what was studied in this Thesis.

One of the programmes in Equinor's road map was commercial insights, by improving analytical tools and data accessibility within the company's commercial areas to enable better decision-making. Based on that, several internal digitalization project initiatives in Equinor attempt to exploit the technological opportunity that digitalization provides.

One of these were analysing and searching for improvement of how the projects are managed and measured in the ongoing projects. Examinees of project needs, and expectation related to having real-time data visualised as a performance measurement system. This was the starting point for the development of performance dashboards. If the proposed performance dashboard qualifies as to achieve its purpose of helping the project members to get an overview of status in the project and contribute to improve information access for stakeholders / decision makers, have not been tested. As mention earlier the internal project are still in the basic engineering phase.

At this stage the benefit of the dashboard in the project execution phase will be the access to real-time data. The status reports in ongoing projects are manually handled, and the status in their report are collected from several different software applications. When real-time data are introduced it will reduce time-consuming manual compilation of reports that are out-of-date as soon as they are created. The real-time data will also reduce faults and filters. Although standardisation, best practices, experience transfer and use of several lean tools related to continuous improvement are used in project execution, still how to utilize and see all the new possibilities related to real-time data are not fully evaluated.

Some challenges have been along the way when working with this Thesis. Probably the biggest challenge was to limit the scope to be able to cover the most important when it comes to project management, project performance and performance dashboards. Several studies and books have arrived the last year on how to measure business and projects and how to present this in a way that it gains the business and or the projects.

Most of the data and information needed from other project have been shared greatly by colleagues. But since some of the data only are available on reposts and document it was sometimes challenging to reach. A challenge has been to assess the relevance of new sources and set a definite limit of including new ones.

The work combination with this Thesis, the internal digitalization project and a position in an ongoing Oil and Gas project gain a lot of priority challenges. This combination has given challenges especially related to the time schedule. There has been to long working hours which has resulted in lower priority of many daily and weekly activities. What kept the motivation, was the possibility to learn and be able to use a lot of the input gained through working with this Thesis. Particularly because it is a highly relevant topic, it appears that the ongoing projects are already or will be influenced by several of the digital trends in the Oil and Gas industry in the years to come.

7. Conclusion

This case-base study has been looking into the improvement opportunities for project performance in connection with industrial digitalization. It is important to understand that digitisation is not the goal itself, but the means to reach the goal.

While studying the digital trends and how the Oil and Gas industry is increasingly dependent on digital systems and technology, it indicates that that key drivers for digitalization are technological advancements, cost focus and anticipation of positive HSE effects.

At the same time, there are some barriers to digitization in the Oil and Gas industry. The industry's high security requirements are part of the explanation. The quality of the solutions is also an important element, while commercial considerations are a third reason.

Equinor have developed a digital roadmap and the internal digitalization project initiative ongoing is one of several digitalization projects. Recommendations given in this Thesis needs to be examine and evaluated in the further development. The performance dashboard which is developed so far will be a foundation for further development of a performance measurement system.

For a company like Equinor the investment of digital solutions like the performance dashboard for project execution may give several new possibilities to perform even better and to have a good overview of the status and performance. By utilising data and information from several applications, merged together to get a better visualization, which gives a better understanding and supportive information to decision makers.

It will improve the work day for several persons in the project, secure the risk base follow-up strategy by using real-time reports and key indicators. The dashboard not only allows you to share whether the project is within budget and on schedule, but it also gives you the tools to share this information quickly without having to jump through the loops of multiple programs. Dashboards gives real-time data and can help you tell the project story. It's easy to dive deep with, as well as see the project with a bird's eye view. All the relevant information and key indicators are presented in a way that it may contribute to better safety, decision making, resource needs - and give higher value.

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