QATAR UNIVERSITY

COLLEGE OF ENGINEERING

IMPACT OF FORCE FACTORS ON THE BENEFITS OF DIGITAL TRANSFORMATION IN THE OIL AND GAS INDUSTRY IN THE STATE OF QATAR

BY

ALI MOHAMMED KH ALKUBAISI

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COMMITTEE PAGE

The members of the Committee approve the Thesis of
ALI MOHAMMED KH ALKUBAISI defended on 20/03/2022.

Dr. Khalifa Al-khalifa
Thesis/Dissertation Supervisor

Dr. Murat Kucukvar
Committee Member

Dr. Veena Bansal
External Examiner

Dr. Mohamed Kharbche
Committee Member

Dr. Galal Abdella
Committee Member

Dr. Ahmed Massoud Abdou
Committee Member

Charritha Dias
Committee Member

Approved:

Khalid Kamal Naji, Dean, College of Engineering

ABSTRACT

ALI MOHAMMED KH ALKUBAISI, Masters: June: 2022,

Masters of Science in Engineering Management

Title: Impact of Force Factors On The Benefits of Digital Transformation In The Oil And Gas Industry In The State of Qatar

Supervisor of Thesis: Dr. Khalifa Al-khalifa.

The oil and gas industry contributes significantly to GDP of Qatar and many other developing countries on the globe. Therefore, the activities of the industry especially its performance and efficiency are critical to their economies. However, since the global drop in the prices of oil and gas products, there have been many efforts on the part of management of these organizations to increase their efficiency and performance. One of the strategic steps suggested by scholars and commentators in industry that should be taken by oil and gas organizations to boost their efficiency and increase their performance is the introduction of digital transformation. In view of the above statement, this study critically investigated the impact force factors on the benefits of digital transformation in the oil and gas industry in Qatar. The researcher adopted the sequential mixed method and collected cross-sectional data using semi-structured interviews and structured self-report questionnaire from 5 managers and 140 employees from the refinery operations. Three research questions and four hypotheses were tested using thematic analysis to analyse the responses to the semi-structured interviews, while structural equation model (SEM) was conducted to test the research model. The result from the thematic analysis revealed that perception of digital transformation was adversely affected by the leaders' perception of its costs in financial terms, security, and data breaches, which might arise from using a business digital

platform. It was also revealed that digital transformation was perceived as being beneficial as the respondents indicated that it could improve performance and efficiency, however, they were weary of its implementation in the entire organization. The SEM showed that perceived risk and perceived opportunity from adopting digitalization, as well as digital organizational culture were significant predictors of perception of digital transformation in the model. Perceived opportunity and digital organizational culture predicted digital maturity. Digital maturity mediated the relationship between perceived opportunity and digital transformation. In conclusion, perceived risk, perceived opportunity, and digital organizational culture were predictors of perception of digital transformation in the oil and gas industry. In view of this findings, suggestion was made regarding reducing the perceived risk and enhancing perceived opportunity with the aid of the organization culture and learning in order to change the perception of digital transformation among key stakeholders.

DEDICATION

This thesis is dedicated to my country for a bright future.

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“I would like to acknowledge my colleagues at work for their tremendous help with the interviews and surveys help”.

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CHAPTER 1: THESIS OVERVIEW

1.1 Introduction

With the advent of alternative energy sources, the oil and gas industry is currently facing some stiff competition and therefore it has become imperative to increase their efficiency so as to reduce cost of operations, especially cost of production. According to Tung et al., (2020), the oil and gas industry is at present going through a fundamental era of digitalization so as to unlock more energy at lower cost and thus attain significant performance improvement. Therefore, to remain competitive, the industry needs to adapt and change their business models to align with the current digitalization efforts, which other sectors are currently benefiting from. For instance, what do companies such as Rosenbauer, Logistics Company DB Schenker, compressor manufacturers such as Bauer, elevator producers like ThyssenKrupp, and Hagleitner, a hygiene goods corporation have in common? They all adopt and benefit from digitization because they offer their customers smarter and better services through digital transformation (DT). This is probably absent in the oil and gas industry with respect to intensity, especially in the State of Qatar despite the crucial roles of the industry in oiling the economy of the small peninsular country.

What is DT? While there has not been consensus agreement among researchers on a unified definition (Schallmo et al., 2017), some scholars (Fitzgerald et al., 2014, p. 2) have defined DT as "the use of new digital technologies such as social media, mobile technology, analytics, or embedded devices to enable major business improvements including enhanced customer experiences, streamlined operations, or new business models". However, the definition of DT offered by Solis et al., (2014) will suffice in this study and they define DT as "the realignment of, or new investment in, technology and business models to more effectively engage digital customers at every touch point in the customer experience lifecycle". Both

definitions conceptualise DT as a form of change that is driven by technology and integrated with the organisation's business model.

The benefits of DT was summarised and classified into the following groups by (Tung et al., 2020): Productivity improvement by adopting maintenance tools that align with data science, data communication, and smart sensors which can be used to prevent machine failure in order to improve productivity. Product quality as well as parameters can be monitored through the entire manufacturing process. Operational cost of production when automated leads to intelligent and visualized production segments, which can reduce the number of employees that are involved in field monitoring, technology systems, machine operation, and logistics. Finally, through DT, workplace safety can be ensured.

However, these benefits have rarely been experienced through DT in the oil and gas industry in Qatar. However, opportunities for DT in oil and gas are plausible due to increasing energy consumption (Tung et al., 2020). For instance, despite the increasing attention to renewable energy globally, oil and gas still remain the biggest sources of energy that are used by the world population and therefore account for 55 percent of total annual consumption (Energy Outlook, 2019). Moreover, since oil and gas exploitation activities have naturally declined, it is only normal for the oil and gas industry in Qatar to adopt DT in order to improve the performance of the industry with technological leaps.

Furthermore, much has been said about DT, but what about the enablers or drivers of DT? The probable reason why DT has not been effective in so many sectors or why some industries such as oil and gas industry in Qatar has not implemented DT is probably because there have not been valid enablers across different industries. Studies (e.g., Reis et al., 2018) note that several research of DT drivers or enablers have been carried out among mostly practitioners who have only been able to present anecdotal evidence. Therefore, lack of empirical studies has marred the understanding of the antecedents (i.e., drivers or enablers) of

DT, while the oil and gas industry in Qatar probably lacks the required wide-range of capabilities for DT, which may differ in terms of importance depending on business context, as well as the specific needs of the industry (Reis et al., 2018).

It is no gainsay that for any new technology to be widely-adopted in any organization, the study of human behavior is not only necessary, but compulsory as the personnel rejection of the technology for any reason results to change failure (Campusneanu et al., 2021). Therefore, in this study, these behaviors that are related to technology acceptance are considered the enablers of DT and therefore the independent variables of the study. For instance, prior studies (Venkesh et al., 2003) have reported that the most important model for predicting technology acceptance for organizational implementation is the unified theory of acceptance and use of technology (UTAUT). On the basis of this therefore, perceived competitiveness, perceived opportunities, perceived risks, perceived vertical network solution etc., are considered as enablers of digital transformation in this study as was done elsewhere (Wang et al., 2016; Muller et al., 2018).

1.2 Statement of the problem

The oil and gas industry in Qatar is currently facing significant shortage in production despite the slump in prices of oil and gas products globally. This thus indicates that producing at the optimal level in order to make up for the low price is a serious challenge in the industry. According to Tung et al., (2020), current oil and gas exploitation activities have declined naturally probably due to the highly competitive renewable energy. It is also possible that the economic crisis in 1997-1998 might have also contributed to the dismal performance of the oil and gas industry. More so, in Qatar, the oil and gas industry is lagging significantly behind in the adoption of new information/communication technologies that can help stimulate better production activities. For instance, in one unpublished study conducted by Al-Azba (2021) in the oil and gas industry in Qatar, the researcher revealed that Industry 4.o despite its positive

perceived contribution to performance, the industry was not ready to take the risk to implement it. Therefore, in the oil and gas industry in Qatar, new technologies are perceived more in terms of risk and very little benefits are seen, which discourage their adoption by the industry.

With regard to literature, a plethora of studies (Shinde et al., 2014; Hagberg et al., 2016; Hess et al., 2016; Parviainen et al., 2017) has been conducted on DT, but only a few (e.g., Campseaneanu et al., 2021; Porter & Hepppelman, 2014) have examined the antecedents of DT in all ramifications. Therefore, majority of extant studies concerning DT are either conceptual analysis or articles written by practitioners which are not empirical. In addition, few extant studies (Tung et al., 2020; Roden, 2016; Joshi et al., 2018) have researched the nature of DT in the oil and gas industry, but they did not investigate the enablers or antecedents of DT in the industry. Therefore, most studies on DT focus on e-commerce and supply chain management. This study is therefore directed at identifying valid enablers of DT in the oil and gas industry in Qatar.

1.3 Purpose of the study

The primary purpose of this study was to critically identify the enablers of DT in the oil and gas industry in the State of Qatar. Previous studies (Roden, 2016; Tung et al., 2020; Duffy et al., 2017) of DT in the oil and gas industry are mainly non-empirical and they are mostly conceptual with almost none of them identifying enablers of DT. It is therefore necessary to identify and test the enablers of DT in the oil and gas industry. In order to achieve this, the following objectives were stated and accomplished in this study:

1. Identify and test the enablers of DT in the oil and gas industry in Qatar.

2. Ascertain the extent to which the enablers influence DT and the factors within the DT.

3. Assess the relationship between the enablers and DT as well as the factors that make up DT.

1.4 Rational for the Study

The study of DT in the oil and gas industry in the State of Qatar has become necessary in view of the need for performance improvement in the sector. Therefore, this study is an addition to the few extant studies that have made attempts to understand the nature of DT and how it can be implemented successfully in the oil and gas industry in Qatar and other countries. Thus, the findings of this study provide the means through which human behaviors that have become cog in the wheel of integrating complete ICT in the processes of oil and gas production activities can be managed for successful ICT operation in the oil and gas industry in Qatar.

The majority of prior studies (Bucherer, 2011; Rusnjak, 2014; Schallmo, 2013, 2014; Thomas, 2014) have investigated DT as a concept, its approaches, and other similar concepts that are related to DT such as digitization, digitalization, Industry 4.0, Internet of Things (IoT), e-commerce etc. But few extant research has been conducted in the oil and gas industry to investigate the antecedents of DT in order to develop more robust framework of DT that exactly aligns with the oil and gas industry in Qatar. To this end therefore, the findings of this study adapted framework from the existing ones that will be more effective means through which increased efficiency can be attained in the industry. This framework will also be useful in other industries, especially in the manufacturing sector.

Since this study is a mixed research design and extant studies in similar direction did not adopt such research design, the findings shall have a far-reaching effect on the contributions of DT to the production aspect of the oil and gas industry in Qatar. Though some of the prior studies of DT and its antecedents (Tung et al., 2020) have also employed survey method, but the survey instruments were largely untested to determine their reliability and validity, which was undertaken in this study. Thus, part of the rational for this study was to revalidate some of the instruments used in previous research to determine how reliable and valid they were.

1.5 Research Questions

Based on the aforementioned objectives of this study, the following research questions will be verified:

1. What are the enablers of DT in the oil and gas industry in Qatar?
2. What are the enablers that have the most effects on DT implementation in the oil and gas industry?
3. To what extent can the enablers contribute to successful implementation of DT in the oil and gas industry?

1.6 Scope of the Study

The main scope of this study was to examine the enablers of DT in the oil and gas industry in the State of Qatar. The respondents of the study were personnel of oil and gas industry in Qatar who worked in the production departments. The research also involved senior production managers, supervisors, middle managers, and lower-level managers who were directly involved in the downstream sector with regard to production.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This part was dedicated to the review of extant studies of antecedents of DT in industries, including oil and gas sector in Qatar. 2.1 reviewed the background of the oil and gas industry in Qatar with regard to digitalization and performance of the industry. 2.2 reviewed past studies of DT as a concept and its consequences in different industries. In 2.3, the review explored the different enablers (i.e., antecedents) of DT as they are related to the oil and gas industry and other organizations. 2.4 reviewed studies which have linked the various enablers to the DT outcomes.

2.2 Background of the Oil and Gas Industry in Qatar

Oil and gas companies have started to embark on different forms of digitalization, capitalizing on promised advantages of the fourth industrial revolution. Presently, the Qatar oil and gas industry has extended shocks in terms of oil price pressure and the pandemic allied with the evolving momentum to transit to a low-carbon future, accelerate the need for oil and gas companies to create new digital plans (Wanasinghe et al., 2020). Oil and gas sector has led the technological curve. However, despite the promising nature of leveraging digital capacity in the industry, the sector has continuously lagged behind other industries when it comes to shifting towards digitalisation and industry 4.0 (Abulhussain, 2021). The shock introduced to the industry by the pandemic in terms of price collapse has forced operators to increase efficiencies by shedding costs, and driving shareholder value, while keeping the public and employees safe.

It is important for the midstream oil and gas industry to enhance digital transformation. From an investment perspective, the oil and gas industry has always preferred using the master limited partnership (MLP) model in the industry, which has always prioritized growth over maintenance. The model restricts emphasis on digital upgraded and this creates a lot of ambiguity around digital investments where technology is most likely to address key business needs (Flaksman et al., 2020). Starting the digital journey requires companies to conduct themselves by undertaking a detailed digital assessment at operational level by using a comprehensive model. This can be achieved using Deloitte's DOT model. This is a framework that intends to explain the digital journey through different stages that are important to oversee the integration of digital capacity. To channel a digital strategy, oil and gas companies in Qatar need to develop a narrative that focuses on improving the supply value chain; aligning digital technologies with operational objectives.

Recently, Qatar's oil and gas market has undergone changes. With the current COVID-19 situation and the challenges it has imposed on oil and gas sector, companies in the industry seem to have resorted to adopting cost effective, optimized solutions to manage operations. More companies in the country are looking at being digital which is currently the emerging trend for world economies (Lu et al., 2019). Experts from Qatar attended the KPMG webinar on Digital Transformation in the Oil and Gas Industry, and they argue that the country is making efforts towards maximizing gas reserves by making wise investments on energy. In the digital age, data is the most important part, and therefore the country is investing in education to understand how to effectively manage digital projects and build capabilities to help with proper technology utilization and achieve national development goals since oil and gas are the backbone of the economy (El-Masri, 2020).

2.3 Digital Transformation

What is digital transformation? While definitional controversy over digital transformation is beyond the scope of this study, the researcher finds it relevant to discuss in brief terms the confusion and the controversy it has generated in all most every field. According to Schalmmo et al., (2017), there is no specific theory of DT that is universally acceptable across all fields or disciplines. This same argument was reiterated by (BDI and Roland Berger, 2015). BDI and Roland Berger (2015) also noted that some concepts are interchangeably used with DT such as digitization, digital business transformation (DBT), digitalization etc., but actually mean different things.

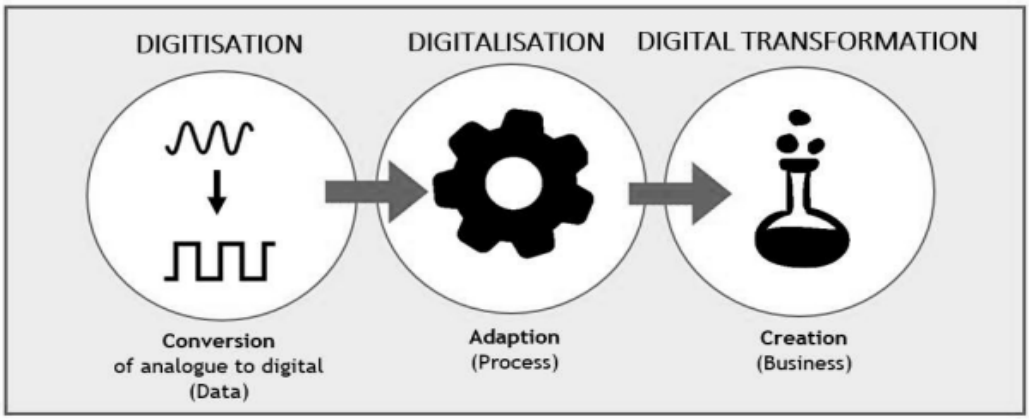


Figure 1 Definition of Digitisation, Digitalisation and Digital Transformation
Source: Maltaverne, 2017.

Fig 1 shows the other concepts related to DT and in fact, have been interchangeably use with DT in plethora of studies (BMWI, 2015; Westerman et al. 2015). However, as demonstrated with the diagram, it can be observed that these concepts mean different things as also explicated in some extant literature (Mazzone, 2014; PwC, 2015).

Ferreira et al., (2017) define DT as a strategy of an organization that is formulated and implemented through capitalization of digital resources with the intent to develop differential value. Bharadwaj et al., (2013), simply defined DT as the degree to which an organization involve in IT-related activities characterized by the adoption of new technology so as to allow a lot of business improvement; while Mithas et al., (2013) defined DT as the adoption of novel technologies such as social media, analytics, mobile so as to allow improvement in business model such as customer experience, make operations become more simplified, create new business model with the aim of improving performance.

It thus shows that DT literature is no as cohesive as one might probably think as there is no consensus among scholars in the field on what constitutes DT in any industry.

Table 1 Digital Transformations Definitions

Table 1. Digital Transformation Definitions.

Author(s)	Definition
Fitzgerald et al. (2014, p. 2)	Digital transformation is the use of new digital technologies such as social media, mobile technology, analytics, or embedded devices to enable major business improvements including enhanced customer experiences, streamlined operations, or new business models.
Westerman et al. (2011, p. 5)	Digital transformation is the use of technology to radically improve the performance or reach of enterprises.
Solis et al. (2014, p. 3)	Digital transformation is the realignment of, or new investment in, technology and business models to more effectively engage digital customers at every touch point in the customer experience lifecycle.
Hinings et al. (2018, p. 53)	Digital transformation is the combined effects of several digital innovations bringing about novel actors (and actor constellations), structures, practices, values, and beliefs that change, threaten, replace, or complement existing rules of the game within organizations, ecosystems, industries, or fields.
Bondar et al. (2017, p.33)	Digital transformation is a consistent networking of all economic sectors and an adaption of actors to new circumstances of the digital economy.
Liu et al. (2011, p. 1728)	Digital transformation is an organizational transformation that integrates digital technologies and business processes in a digital economy.
Stolterman et al. (2004, p. 689)	Digital transformation comprises the changes associated with the application of digital technology in all aspects of human society.
Martin (2008, p. 130)	Digital transformation is the use of information and communication technology, not when trivial automation is performed, but in the case where fundamentally new capabilities are created in business, public government, and in the lives of people and society.

Source: Kraus et al., 2021

Table 1 shows the various definitions of DT from literature with different studies indicating the extent to which DT is defined by scholars and the variations in what they think constitutes DT across all fields. For instance, some researchers (Verhoef et al., 2019;Kane,

Palmer, Philips, Kiron, & Buckley, 2015; Liu, Chen, & Chou, 2011) argue that DT should be defined and investigated using multidisciplinary approach. They contend that one single field cannot be exhaustive in providing the entire information regarding DT. However, extant studies of DT have mainly examined DT on the basis of sectors, industries, or disciplines (Lamberton & Stephen, 2016; Kannan & Li, 2017).

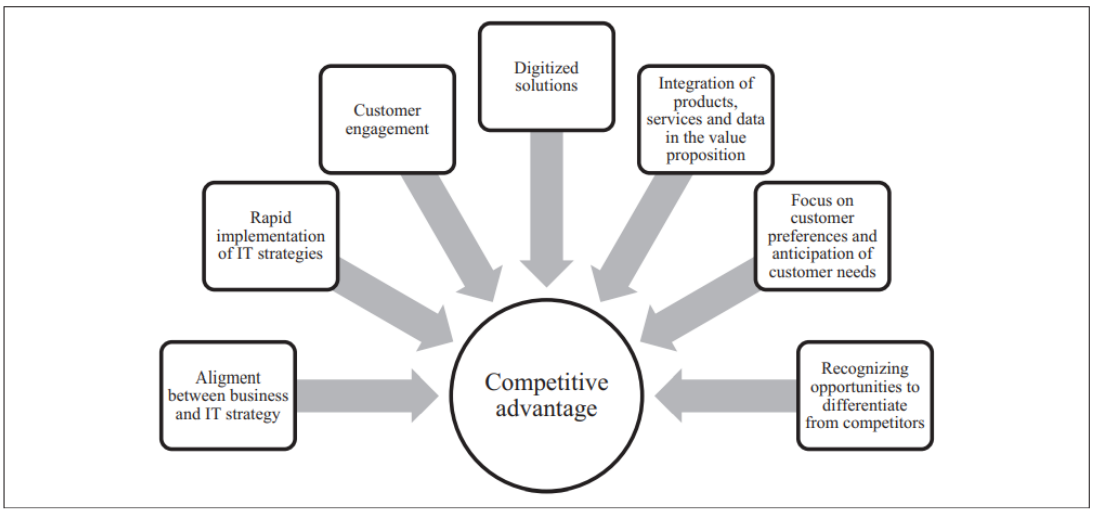


Figure 2 shows the different combination of business strategies that can lead to competitive advantage, Source: Kraus et al. 2021.

Researchers in marketing for instance, have focused their attention mainly on digital advertising and the effects of social media (Lamberton & Stephen, 2016; Kannan & Li, 2017) and multi-channel as well as omni-channel developments (Verhoef, Kannan, & Inman, 2015). On the other hand, the strategic management literature has had their attention focused on DT conceptualization, operationalization, as well as digital business model renewal (Foss & Saebi, 2017; Osterwalder & Pigneur, 2010). In the information system literature, scholars have concentrated their attention on technical developments of DT which focus on adoption, and utilization of digital technologies and its consequent business value (Nambisan, Lyytinen, Majchrzak, & Song, 2017; Sambamurthy, Bharadwaj, & Grover, 2003). Thus, the definitions of DT are strongly influenced by the orientation of scholars or the field they belong.

2.4 Antecedents of DT in the Oil & Gas Industry

There have been research (Hess et al. 2016; Karimi and Walter 2015; Kutzner et al. 2018; Park and Mithas 2020; Svahn et al. 2017; Tallon et al. 2019; Tumbas et al 2018) on the antecedents of DT in different sectors. In this study, the antecedents are the drivers or enablers of DT in the oil and gas industry in Qatar and indeed other sectors of the economy globally.

2.4.1 Digital Maturity

Previous research (Campusneanu et al., 2021) indicates that the most consistent antecedent of DT is digital maturity. Digital maturity is defined as the capabilities that an organization possesses with regard to digital resources to execute the strategy of the organization (Salume et al., 2021). Thus, it is argued that DT is only a part of organizational strategy and therefore DT is not a strategy on its own (), but incorporated within the strategy of an entity. It is also argued that DT is driven by strategy and not technology (Ismail, Khater & Zaki 2017; Kane et al.2015) Requiring executives of business to understand the import of digital maturity has become imperative due to their narrow knowledge of DT resulting in their inadequacy to know the factors that are required for an entity to become successfully digitally transformed (Salume et al. 2021).

Moreover, due to paucity of research linking digital maturity to DT, the very components of digital maturity that are related to DT is a subject of confusion and controversy among scholars (Hell et al., 2016). This might partly explain why many organizations, including the oil and gas industry in Qatar still grapple with implementation of successful digital transformation as many of these organizations still lack digital maturity and therefore struggle with DT processes (Kane et al., 2017). More so, digital maturity as a concept is also not free of confusion and controversy as different scholars have different approaches and frameworks outlining the concept and its measurement (Rossmann, 2018). Additionally, eight capability dimensions of digital maturity were identified through review of literature by

(Rossmann, 2018). These capabilities were: the strategy, the market, the leadership, the operations/ the operational system, the people, the culture, the governance, and the technology.

Findings regarding the relationship between digital maturity and DT are mixed as some extant research (Hess et al., 2016) reported positive association between some elements of digital maturity and DT, while other studies (Karimi and Walter 2015) did not find such association. In particular, prior empirical research (Benbya et al. 2020; Selander et al. 2013) found that dynamic capability, an antecedent of digital maturity, has position relationship with DT. The researchers therefore concluded that DT was a function of dynamic capability. The studies carried out by IS researchers (e.g., Tallon et al. 2019; Fuchs and Hess 2018; Gerster 2018; Leonhardt et al. 2017; Vial 2019) lent support to this conclusion.

2.4.2 Forces Related to Personnel Behavior

For successful implementation of any technology, the study of human behavior is important as resistance to any change whether it is policy or any other fundamental change by the employees may often result to the failure of change initiative (Balogun & Hopewell, 1994). Therefore, theories such as the (UTAUT), Theory of Technology Acceptance (TAM), Motivated Action Theory, Model of PC Use (MPCU), Perceived Behavioral Change theory (PBC) are some of the models that have been use severally to explain how individuals accept or reject new technologies in modern business organizations (Căpusneanu et al. 2021).

Prior studies (Eriksson & Penker, 2000; Schallmo, 2013) have related a host of human forces to acceptance of a technology, including DT. Information Communication technology (ICT) has the potential to enhance the performance of an organization by affecting the entire processes (Kryvinska et al. 2015). But this can happen perhaps only when the human factors are well taken care of, as inability to carry the personnel along, no matter how effective the technology might be, the desirables outcomes might not be achieved as it has been reported in

change management studies (Balogun & Hopewell, 1994). To this end, forces such as perceived opportunities (Argenti, 2016; Roy &Khastagir, 2016); and perceived risk (Muller et al. 2018; Flat et al. 2016) are human-related factors that have been reported in previous research to impact on successful DT.

2.4.3 Perceived Opportunity (PO)

Perceived opportunity is defined as subjective feelings or perception that organizational members have regarding the benefits that may accrue to them and the organization during the introduction of new technology. Perceived opportunity for using new technologies may result in technology acceptance, may also breakdown employee resistance, and has also been related to organizational efficiency, product quality, safety, as well as process improvement (Argenti, 2018; Roy & Khastagir, 2016). Perceived opportunity among organizational members may also facilitate change in business model since it allows the members of the organization to support technological innovation. However, mere perception of opportunities in new technology might not be adequate in facilitating technology acceptance. The reason is that there are other salient factors. For instance, if new technology will result to streamlining the labor force or loss of job position, it is likely that organizational members may see it as a threat and therefore develop negative attitude towards the idea, which will lead to resistance (Aeppel 2015; The Economist 2014).

Christensen (1997) divided new technology into two categories: sustaining and disruptive. Sustaining refers to new technology that relies on incremental improvements to technology that is already established. Whereas, disruptive technology refers to new technology that does not have refinement, which has performance-related issues because it is new, is only accepted by few individuals, and void of practical application (Christensen, 1997). Intuitively, organizational members will be more welcoming of sustaining technology and should be more resistant to disruptive technology. It might be therefore difficult for

organizational members to perceive more opportunities in disruptive technology than sustaining technology. For instance, it has been reported that advances in technology are destroying more jobs that it is creating especially in developed economies (Brynjolfsson & McAfee, 2014; Rotman, 2013). This therefore implies that the introduction of new technology and opportunities may not necessarily lead to successful implementation of DT in the oil and gas industry. Perhaps, the slow pace of technology implementation in the industry may not be unconnected with the fact that it will destroy more jobs or eliminate some totally (Brynjolfsson & McAfee, 2014; Rotman, 2013).

2.4.4 Perceived Risk (PR)

While technology has several benefits whether perceived or real as technology helps to facilitate performance, integrates business model with organizational strategy, and also creates faster and smarter link between customers and service providers. It can also be a source of issues and problems for organizations in the oil and gas industry (Tung, 2020). The risks in technology such as the adoption of Industry 4.0 can expose oil and gas companies to risk of hacking, information theft, identity theft, data loss, data manipulation, cyber attacks etc., (Flat et al., 2016).

While it is possible that cyber security issue is a strong threat that personnel and their organizations in the oil and gas industry in Qatar might want to avoid and perhaps makes technology adoption slow in the industry, previous studies have documented the extent of technology acceptance in the oil and gas industry. A study conducted by Deloitt in 2015 rated digitalization in the petroleum industry 4.68 on a 10-point scale (Gerald et al., 2015). However, other studies (e.g., Tung et al. 2020) noted that the low technology penetration in the oil and gas industry was due to lack of finance and not due to perceived risk. Therefore, Rung et al., (2020) asserted that only few of the big oil and gas companies are fully digitalized as there are

few sectors in the oil and gas industry that can afford new technologies. These technologies are limited to field management, production, and maintenance (Tung et al. 2020).

2.4.5 Digital Organizational Culture

The culture of an organization is a critical factor in the management of the affair of the organization, and plays crucial role in organizational change (Bate et al., 2000; Curry, 1992; Hercleuous, 2001; Wilkins & Dyer, 1988) such as digitalization ((Duerr et al. 2018; Hartl and Hess 2017). However, dearth of studies of marred the understanding of the relationship between digital culture and DT. According to Hartl and Hess (2017), there are three cultural factors that are relevant for DT, which are clustered in 3 main cultural orientations: externally oriented culture, flexibility and adaptability, and internally directed culture. Culture of an organization can be artifacts, beliefs, values, and underlying assumptions (Schein., 1990).

Culture of an organization is a powerful factor which influences many activities within an organization and therefore also exerts influence on DT (Kane et al. 2017; Leidner and Kayworth 2006; Vial 2019). Therefore, it is argued that if organizations must implement successful DT, they must consider the new aspects of their culture which are pertinent to their digital culture and that can transform their structures, values, and assumptions during DT transformation (Kane et al. 2017; Schein 1990; Vial 2019). However, these scholars did not indicate whether digital culture is quantitatively related to DT or some of the elements of DT. Kane et al., (2017), Schein (1990), as well as Vial (2019) suggested that for organizations to attain successful implementation of DT, they must adjust their strategies of engagement using their digital leader, different platforms for learning, new technologies, possess a digital mindset, and new ethical styles of operations within the organization. However, these suggestions were based on anecdotal evidence and not empirical findings. It is therefore imperative to put these factors to empirical tests.

2.5 Consequences of DT in the Oil & Gas Industry

However, while there are different approaches to DT in literature, there is a convergence of opinions among scholars on the outcomes of DT in different industries (Căpusneanu et al. 2021). For instance, managers and other relevant personnel when using the tools that are inherent in the digital environment such as big data analytics, IoT, cloud computing etc., it encourages the development of digital culture. The benefit of this is that it fosters a way of working which forces organizations in the oil and gas industry in Qatar and other countries to improve as well as continue digital learning (Căpusneanu et al. 2021). Through adopting a strategy that emphasizes continuous improvement, organizations can increase their agility using DT, especially when it involves getting into specific target market and thus gives allowance to faster adaptation as well as innovation.

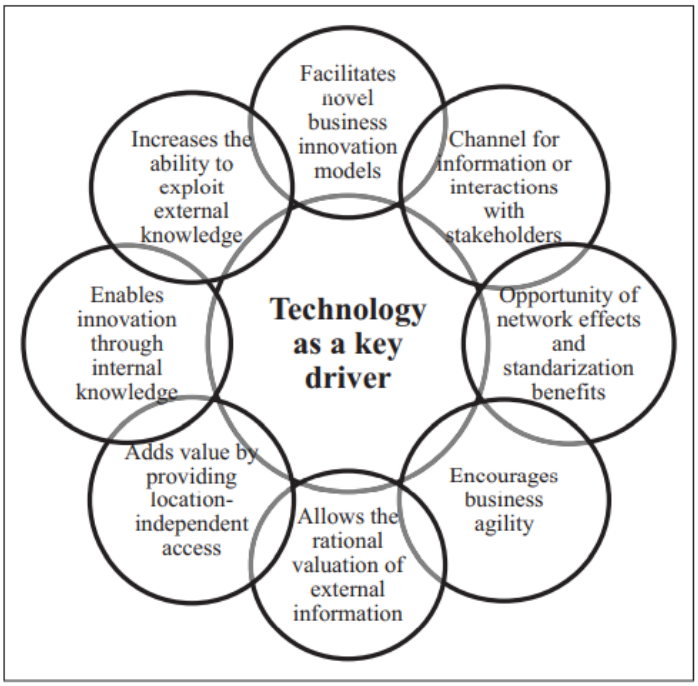


Figure 3 Benefits of introducing technology into business, Source: Kraus et al. 2021

Organizations which are successful in their implementation of DT make efficiency possible as well as increase their profitability through increase in their market share (Căpusneanu et al. 2021). It has also been noted that DT allows streamlining through automating manual tasks and integrate data across the entire organization will directly impact on productivity. DT has also been noted to reduce cost and increase sales through optimizing business technology as well as digital technology operations. So many benefits of DT have been highlighted in literature through the outcomes that accrue from the various enablers. However, what is obvious regarding the so called DT outcomes identified in literature is that they were not empirically tested. They are results from suggestions, literature reviews, and practitioners' articles. It is therefore necessary to empirically verify these outcomes in order to valid the various claims.

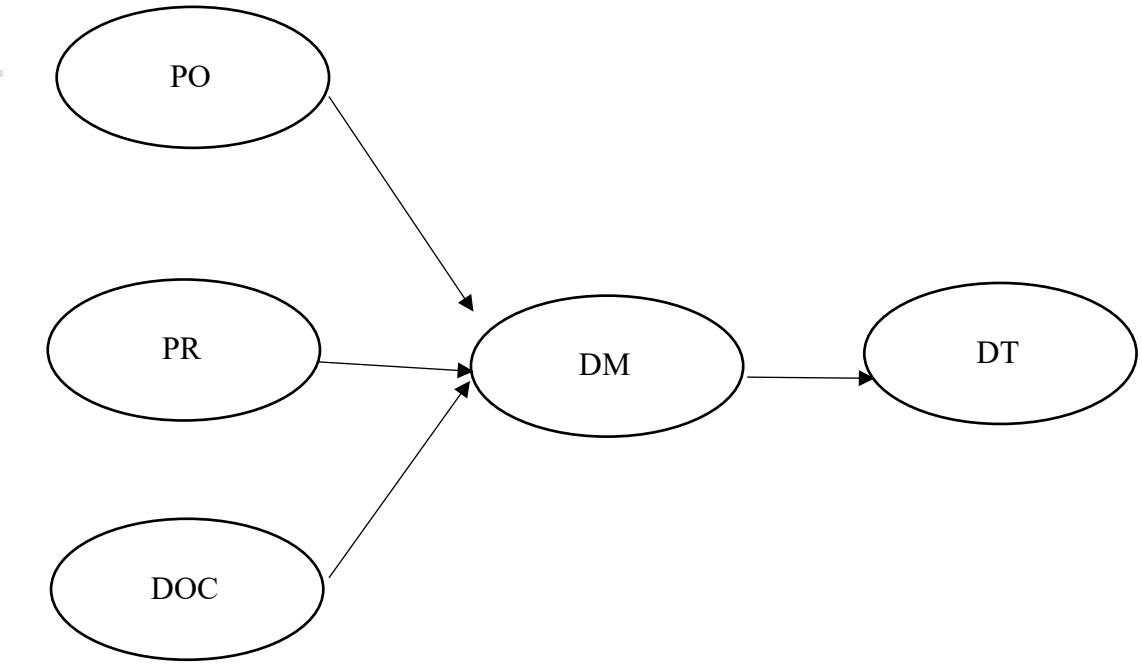


Figure 4: research framework

Fig 4 is the research framework which examined the relationship among the independent variables, mediator, and dependent variable of the study. In other word, the research sought to find linkages among the variables of the study in order to understand how they all lead to digital transformation in the oil and industry.

2.6 Statement of Hypotheses

Hypothesis 1: There will be positive association between perceived opportunity (PO) and digital maturity (DM).

Hypothesis 2: There will be positive association between perceived risk (PR) and digital maturity (DM).

Hypothesis 3: There would be positive association between digital culture (DC) and digital maturity (DM).

Hypothesis 4: digital maturity (DM) would mediate the relationship between digital culture and digital transformation (DM).

CHAPTER 3: METHODOLOGY

3.1 Introduction

This part described the various methods employed by the researcher to achieve the objectives of the study. 3.1 explained the research paradigm; 3.2 described the research method adopted; 3.3 explicated the research approach which choice was hinged on the research philosophy chosen for the study; 3.4 discussed the population frame; 3.5 mentioned the research instrument; 3.6 pilot study; 3.7 highlighted the data collection procedure; and 3.8 explained the data and statistical analyses.

3.2 Research Paradigm

Paradigm is apparently a nebulous concept as it has been used and defined in different manners by scholars in different disciplines (McDonald, 2011; Guba & Lincoln, 2004). The American philosopher, Thomas Khun (1962) was first credited with the use of the word, paradigm as a way of thinking. However, in recent times, paradigm has been defined and understood as a worldview (e.g., Mackenzie & Knipe, 2006). To this end, research paradigm refers to approaches, a set of shared beliefs, or school of thoughts which informs the interpretation or meaning of a research data (Kivunja & Kuyini, 2017).

Major paradigms in social sciences are divided into epistemology, ontology, methodology, and axiology (Gall et al., 2003; Richard, 2003). Epistemology is defined as how something gets to be known. That is, the nature of knowledge and how it is acquired or becomes validated (Gall et al., 2003). Ontology on the other hand refers to the nature of our belief regarding reality (Scotland, 2012). Methodology describes the method employed in the research such as research design, while axiology means ethical aspects involved when planning research proposal (Finis, 1980).

With regard to epistemological approach, this study adopted pragmatism. Pragmatism refers to a world view which aims to offer solutions to practical problems through both singular and multiple realities in the world (Feilzer, 2010; Morgan, 2007). The main idea behind the use of this paradigm is because the research of digital transformation and factors influencing it are basically exploratory as the research of digital transformation is relatively new (Schalmmo et al., 2017). Therefore, it was necessary to employ a mixed research method as it allows the researcher to employ multiple methods to achieve the research objectives of finding out the impact of force factors on the benefits of transformation in the oil and gas industry in Qatar.

The benefits of using pragmatism in this study over positivist and interpretivist approaches, include ability to study in-depth the perception of digital transformation in the oil and gas industry in Qatar; involving the personal experiences of the research participants and that of the researcher; being able to collect numeric data to find relationship between the force factors and digital transformation etc. However, pragmatism has limitations too (Feilzer, 2010) such as generating too many variables that are hard to measure and correlate. Thompson (2007) also identifies the problem of pragmatism that is contextual, and problem-centered. However, pragmatist approach was considered most appropriate in view of the explorative and confirmatory approaches of the study.

3.3 Research Approach

There are three main research approaches based on (Saunders et al., 2019). They are deductive, inductive, and abductive. Deductive, according to Creswell and Plano (2007) refers to research approach in which the researcher starts from top-down, from a theory to hypotheses, collecting data in order to support or oppose a theory. In contrast, Creswell and Plano (2007) define inductive approach as a research in which the participants' views are used by the researcher to develop themes and make those themes to be connected to a theory. With respect

to abductive approach, it is defined by Saunders et al., (2019) as an approach that utilises both inductive and deductive approaches and thus goes back and forth. While deductive approach is associated with quantitative method and inductive to qualitative method, abductive is related to mixed method and pragmatism (Saunders et al., 2019).

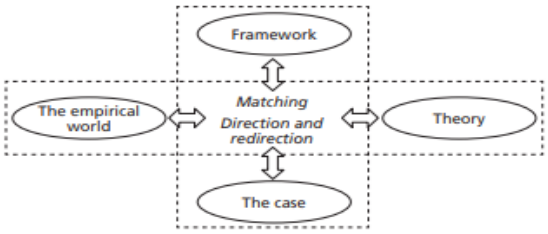


Figure 5 Abductive approach, Source: Dubois and Gadde, 2002

Furthermore, the justification for using abductive approach in this study was because of the epistemological perspective adopted, which was pragmatism (Saunders et al., 2019). Some of the merits of using abductive approach are: it takes into consideration the subjective and objective perspectives (Gray, 2009) of studying force factors and their relationship with digital transformation in the oil and gas sector in Qatar; abductive approach just like pragmatic approach also solves practical problems by emphasising commonsense, and scientific approach embedded in pragmatism (Ormerod, 2006). However, critics of abductive approach have identified some limitations such as the results obtained from abductive approach being weaker than those derived from either inductive or deductive approach (Behfar & Okhuysen, 2018) and that findings from studies which adopt abductive can also hardly be replicated (Bamberger, 2019). However, despite these criticisms abductive approach was deemed the most suitable given the objective of the study.

3.4 Research Method

Research method is mainly divided into three (Creswell, 2008; Saunders, 2019): qualitative, quantitative, and mixed method. Qualitative research method collects non-quantitative data such as observation, pictures, stories etc (Muijs, 2010); quantitative research approach makes use of statistics or mathematics through the collection of numeric data (Creswell, 2008), while mixed method research makes use of both qualitative and quantitative data by collecting the data simultaneously or sequentially (Creswell & Plano Clarke, 2011). Therefore, because this study was pragmatic with regard to research paradigm and it also adopted abductive approach, the researcher used mixed method.

Researchers (e.g., Creswell, 2015) have documented the merits of mixed method some of which are flexibility in being able to combine two different methods to solve the research problems; when dealing with human experience such as digital transformation in the oil and gas industry in Qatar, according to Stake (2010), the use of statistics alone might be confusing, but when combined with qualitative might give clearer picture of the outcomes of the study through meaning-making during interpretation; and mixed method also allows generating multiple venues for understanding the phenomenon of digital transformation (Alsawaier, 2019). However, critics of mixed method have pointed to the following weaknesses and limitations:

3.5 Population Frame

Population frame refers to a list of the entire elements in a specific general population that the researcher is interested in from which the sample for the study may be drawn (Sekaran, 2006). Table 1 and Table 2 show the population of the entire workforce in the selected departments of the organisation, including their managers, lead, and assistant managers with respect to their population. The entire workforce in the five selected departments, which were production, maintenance, safety, business support, and asset and integrity are presented in Table 1 and Table 2. However, studies (e.g., Mugenda & Mugenda, 2003) have shown that when the population is relatively small and it within a geographically narrow area, the target population is said to be closely comparable to the population that is assessed.

Furthermore, within the pragmatic paradigm, the sample that is practically accessible with respect to the population is where research participants are selected as practicability underlies the principle of pragmatism (Morgan, 1997). Therefore, the employees in the five selected departments, including their managers were judged to be close with regard to accessibility to the general population of employees in the organization. Thus, the employees and their managers, including supervisors, lead, and assistant managers were given the opportunity to be selected into the study. In addition, in most cases, in the oil and gas industry digital transformation tends to be domesticated in those five selected departments, especially in field management, production, and maintenance (Tung et al., 2020; Deloitte, 2015).

Table 2 Target population based on departments and the population of workforce in refinery operations.

S/N	Refinery Operations		
	Department	Sector	Workforce Population
1	Production	Downstream	347
2	Maintenance	√	148
3	Asset & Integrity	√	86
4	Business Support	√	107
5	Safety	√	49
Total			737

Source: Research Data

Table 1 shows the target population with respect to the target departments and the number of workforce in each of the selected department in refinery operation. Production has the largest population (n = 347) and was followed by maintenance (n = 148); business support (n = 107); while safety (n = 49) had the lowest population. In order to know the specific samples drawn from each of these departments in the quantitative phase of the study, chapter four of this report describes it in details.

Table 3 Population of managers in the selected departments in refinery operations

S/N	Department	Refinery operations	
		Downstream	Population of Managers
1	Production	√	7
2	Maintenance	√	5
3	Asset & Integrity	√	5
4	Business Support	√	5
5	Safety	√	5
	Total		27

Table 2 shows the population of senior managers in the refinery operations who were targeted for the semi-structured interviews. It can be observed from fig 2 that in each department there were total of five managers. It was from this population that the interviewers were selected for the qualitative phase of the research.

3.5.1 Target Population

Ross (2005) suggests that researchers should distinguish target population, population from which the result will be derived, the desired target population, and the population which is the focus of the study. Therefore, the target population can be defined as the group of individuals the researcher plans to select and through which conclusion would be made regarding the findings of the study (Barnsbee & Nghiem, 2018). In this study, the target population were managers and employees in the X organization, which included Maintenance, Production, Asset & Integrity, Safety, and Business Support departments in refinery operations of the downstream sector of the oil and gas industry in the State of Qatar. The justification for limiting the sample to those in the five selected departments of the organization was because prior studies (e.g., Tung et al., 2020; Deloitte, 2015) of digital transformation in the oil and gas industry reveal that field management, maintenance and production are the initial venues for the complete digitalization in the industry.

3.5.2 Sampling Strategy

Sampling strategy refers to whether the researcher employed random or non-random sampling strategy in the selection of the respondents (Muijs, 2010; Etikan & Bala, 2017). Random or probability sampling is defined as sampling strategy in which the researcher gives equal opportunity of being selected to all the elements within the population, whereas non-probability or non-random selection is a sampling strategy in

which the researcher decides how the sample of the study will be selected or decides the criteria that will be used to make the selection (Etikan & Bala, 2017). Some examples of probability sampling are simple random sampling, stratified sampling, and clustered sampling, while examples of non-random sampling are quota sampling, convenience sampling, purposive sampling (Muijs, 2010; Etikan & Bala, 2017).

In this study, the non-random sampling strategy of convenience and purposive sampling methods was employed for the quantitative and qualitative phases, respectively. Convenience sampling according to Etikan et al., (2016) refers to the method of selection in which the researcher selects those who are accessible, willing to participate, and are convenient to be sampled, while purposive sampling has to do with selecting those who have the knowledge and experience. The justification for using these sampling methods was predicated on the difficulty of recruiting oil and gas workers who are highly busy and therefore would not be suitable for random selection. Though random selection is noted be scientific and bias free (Etikan et al., 2016), but all selection methods do have one form of limitations or the other (Kriska et al., 2013), and that convenience samples do have value, but not as much as random samples (Deming, 1966).

3.6 Instrumentation

There are different tools that are employed in the collection of data such as survey, questionnaire, interview, observation, checklist, Focus Group Discussion (FGD), photography, video etc. Studies reveal that often times, the methodology chosen by a researcher can be determinant of the appropriate tools to be used to collect relevant data. Therefore, in close relationship with the pragmatic stance (i.e., mixed method), use of structured questionnaire and interview is in line with the objectives of this study.

Thus, close-ended questionnaire and semi-structured interviews were used to collect relevant information.

The semi-structured interviews asked questions regarding digital transformation, digital maturity, digital culture, and individual force factors that affect digitalization in the oil and gas industry in the State of Qatar. The interviews involved managers in the five selected departments. The interview questions were moderate with respect to the language used and there was also flexibility with regard to language as the interviewers decided the language in which they would want the interviews to be conducted. However, by default, English was made the language for the interviews.

Structured questionnaire was also used to collect information regarding the variables of interest. Questionnaire was revealed to be the most important tool for getting honest responses from respondents (Welman et al. 2005). The questionnaire was structured in the following manner:

3.6.1 Section A: Socio-Demographic Characteristics

This segment of the questionnaire captured information about the personal background of the respondents. These were gender, chronological age, department, job position, work experience, and highest level of education. It was necessary to request for this information from the respondents as studies (Goswami & Upadhyay, 2019) have shown that personal background of employees or individuals affects work-related outcomes and thus affect their adaptation to DT. Moreover, some of the demographic variables have been noted to be confounders (Jenicek & Cleroux, 1982). Confounders are defined as variables that though are not originally part of a study, but nonetheless can have effects on the dependent variable and therefore distort the result of the study

(Elwood, 1988). Therefore, in order to control for their influence on the dependent variable, they must be drawn into the study (Jenicek & Cleroux, 1982).

3.6.2 Section B: Perceived Risk Questionnaire (PRQ)

This aspect of the questionnaire was used to collect information about the perceived risk of digitalization in the oil and gas industry in Qatar. Prior studies (Sharma, 2013; Kim & Kankanhalli, 2009) have implicated perceived risk in the acceptance of new technology among end-users and as part of the Technology Acceptance Model (TAM). Therefore, it was necessary to include perceived risk amongst the force factors in the predictive model. The four items that were used to measure perceived risk were adapted from Im, Kim, and Han (2008) which were developed based on the following criteria: financial (if it is worth the cost), performance (effectiveness), social (changes at work), psychological (frustration), and physical (comparison to other products).

The four items are negatively worded such that high scores represent high perceived risk, while low scores reflect low perceived risk of digitalization. The authors report reliability alpha coefficient of 0.749 for the four items in the scale.

3.6.3 Section C: Perceived Opportunity Questionnaire (POQ)

Past studies (Davis, 1993; Davis, Bangozi and Warshaw, 1989) have shown that perceived opportunity is a driving force for adopting a new technology and TAM also lends support to this assertion. Therefore, perceived opportunity was included in the study as in independent variable and measured using a self-report questionnaire developed and validated by Skoumpopoulou et al., (2018) to assess performance expectancy of a new technology, but was adapted in the present study to measure perceived opportunity in the adoption of digitalization in the oil and gas industry.

Furthermore, the scoring procedure for this scale was such the higher the score, the higher the perceived opportunity for adopting a new technology and the lower the score the lower the perceived opportunity for adopting a new technology. Skoumpopoulou et al., (2018) reported reliability alpha coefficient of 0.875. However, the questionnaire was subjected to revalidation due to the research setting of this study.

3.6.4 Section D: Digital Culture Questionnaire (DCQ)

This section of the questionnaire was used to assess organizational digital culture. The DCQ is a 4-item questionnaire that assesses digital culture and it is a subscale of the digital maturity questionnaire developed by (Rossmann, 2018). The self-report questionnaire required respondents to indicate their levels of agreement or disagreement on a 5-point Likert type rating scale. The four statements in the questionnaire were positively worded and therefore, respondents who scored high in the scale was interpreted as having strong perception of digital culture in their organizations, while those who scored low was interpreted as having weak perception of digital culture in their organizations.

The questionnaire was revalidated in this study so as to determine the suitability or otherwise of the four statements in the questionnaire in the present study. However, Salume et al., (2021) reported reliability alpha greater than 0.70, the discriminant validity was obtained as 0.671.

3.6.5 Section E: Digital Maturity Questionnaire (DMQ)

Digital maturity, according to literature (Salume et al., 2021) precedes digital transformation and therefore, for an organization to be digitally transformed, it is important to first gain digital maturity. In view of this, it was important to include digital maturity as a moderator. Moderators are variables that bring about effects between the independent and the dependent variables thereby altering the relationship between the

exogenous and the endogenous variables (Edward & Lambert, 2007). The DMQ is comprised of the following subscales: strategy, market, operations, culture, and technology. It consisted of 19 statements and was developed by Rossmann (2018). Though Rossmann (2018) version of this questionnaire was anchored on an 11-point response format, but in this present study, it was adapted to a 5-point Likert type rating scale. The justification for this was that it was necessary the entire questionnaires used in this study have similar rating and anchors.

The higher the respondents' scores on the questionnaire, the higher the digital maturity of their organizations and the lower their scores, the lower the digital maturity of their organizations. According to Salume et al., (2021), the DMQ has composite reliability alpha coefficient that is greater than 0.70, while for the subscales 0.951, 0.918, 0.932, 0.902, and 0.926 were obtained for technology, market, operations, culture, and technology respectively. The questionnaire was revalidated through pilot study to ensure it is suitable in the present research setting.

3.6.6 Section F: Digital Transformation Questionnaire (DTQ)

This instrument was used to assess the extent to which the respondents perceived the effort towards digital transformation in their organization. The self-report questionnaire was developed and validated by Goswami and Upadhyay (2019) to measure the degree of digital transformation in organizations. The scale is a multi-dimensional instrument for measuring DT and therefore comprises the following subscales: customer experience (4 items), operational efficiency (4 items), and business modelling (2 items). To arrive at the respondents' score on DT, the researcher simply computed their composite scores on the DTQ.

Goswami and Upadhyay (2019) reported reliability alpha coefficient of 0.671 for the 10 items in the DTQ. However, they did not indicate the reliability alpha coefficients for the three subscales. The DTQ was revalidated through a pilot study in the present research setting to determine its suitability or otherwise prior to adopting it for the main study.

3.7 Pilot Study

A pilot study was conducted to enable the researcher to determine the suitability of the research questionnaire for the quantitative phase of the study. This was because the scales used for the study were developed in different research settings. Researchers (Beijing et al., 1998; Dwairy, 2004) have suggested that while it is appropriate to adopt existing psychometric scales, such instruments should be subject to revalidation by adapting it and selecting those statements that are of cultural relevance and expunging those that are not so as to ensure they are suitable for use in the research setting.

The researcher conveniently selected 30 respondents in the same organization where the main study was carried out. However, those selected to respond to the questionnaire were from departments such as human resource, training etcetera, and not from any of the 5 departments selected for the main study. This was done to avoid questionnaire sensitivity which could bias the findings of the study. The respondents were given two working days to complete and submit the electronic questionnaire. The entire 30 copies of the questionnaire were returned and there was none invalidated.

The researcher revalidated the questionnaire by subjecting the items responded to reliability alpha coefficients. The scales were initially put together for principal factor analysis (PFA) and 5 factors emerged indicating that the factors are independent, but some have close relationships due to their being subscales or the factors being multidimensional. With regard to item by total correlation, the alpha for the items

ranged from 0.901 to 0.908. This shows that all the items were suitable for use in the main study. But the researcher still changed some wording in some of the statements in order to make them simpler to be understood by the respondents.

3.8 Data Collection Procedure

For the main study, the researcher initially had approval from the university to carry out the study. There was also need to obtain informed consent of the organization which was used to distribute the survey to their employees. Semi-structured interviews were initially conducted in order to have the direct views of those who were in the management and director positions as they are responsible for the digital transformation policy. The qualitative data for the study was drawn from five managers in the X organization and from the 5 selected department earlier mentioned in this report. The qualitative phase of the study was first carried out because it allowed the researcher to have better grasp of the nature of the study, which was used to improve the quantitative phase of the study. Each of the semi-structured interviews which were carried out physically and on-face-to-face basis took 25 minutes on average.

The researcher had to be very patient as the interviewees were very busy and there was also the issue of Covid-19 and therefore this made it a little problematic to carry out the interviews. Each of the five interviews was conducted within two weeks and the interviewers were told if they wanted to have the final report of the study, they could give the researcher their email addresses.

For the quantitative phase of the study, the researcher sent invitation to the respondents through email and this was done on individual basis so as not to give the impression that important confidential personal information may be shared with any of the respondents which may discourage some of them in being selected into the study. The researcher distributed the questionnaire electronically through Survey Monkey and

ensured that there was complete anonymity. The questionnaire took around 5 minute to complete electronically and this motivated the respondent to respond to the questionnaire as quickly as possible. The researcher gave them 7 working days to complete and return the questionnaire.

However, the respondents did not respond to them quickly contrary to the expectation of the researcher. Therefore, it took more than two weeks to complete the administration of the questionnaire and get back the filled copies of the questionnaire.

3.9 Data & Statistical Analysis

The data collected through the semi-structured interview were subjected to thematic analysis by sieving out the most recurring themes. It is necessary to point out that before subjecting the data to thematic analysis the data was managed by assessing its trustworthiness, conformability, and credibility. This was to ensure their authenticity as suggested in previous studies (Elo et al., 2014; Kyngas et al., 2011). Elo and Kyngas (2008) suggest researchers in qualitative study must ensure alignment between the data and the objective of the study and that there should be clear linkage between the data and the results. These suggestions were all taken into cognizance during the data analysis. The thematic analysis was used to provide answers to the research questions posed in chapter one of this report.

For the quantitative method, the researcher subjected the 150 data to complete data management process, thereby ensuring that outliers are eliminated, empty cells were eliminated, and other unnecessary elements in the data were completely expunged before analysing the data. The 150 data set was analyzed using the IBM Statistical Package for Social Sciences (SPSS) version 25.0.

The statistical analysis was divided into three categories which were descriptive, scale revalidation, and hypothesis testing. With regard to descriptive analysis, the researcher analyzed the socio-demographic variables, which included gender, age, job position, work experience, and education by using descriptive statistics such as mean, standard deviation, percentage, and frequency distribution. Additionally, pie and bar charts were employed to analyze the personal information of the respondents.

Furthermore, in order to test the reliability alpha coefficients of the self-report scales, Cronbach (1951) reliability coefficient relationship test was conducted for each of the scales ranging from the DTQ to digital culture questionnaire. The Cronbach (1951) test allowed the result to identify the relationship quality among the items in each scale and to determine the items with weak relationship with other items in the same psychometric scale.

For the test of the hypotheses, multiple regression analysis and structural equation modelling (SEM) was used to find the relationship between the independent variables, moderators, and the dependent variables.

CHAPTER 4: RESULTS AND DATA ANALYSIS

4.1 Introduction

This aspect of the study presents the findings of the qualitative phase of the study by analysing and interpreting the results based on the research questions and objectives of the study.

4.2 Content Analysis of Interviews

Based on the research questions and the objectives of the study, the semi-structured interviews were divided into 7 main categories which are: the meaning of digital transformation to business leaders in the O&G industry in the globe and in Qatar, where digital transformation should begin in the O&G industry, barriers that usually block the path to digital transformation, digital platform of O&G, the need for digital platform, and reason for choosing one digital platform over the other, digital transformation perception amongst employees, meaning of digital maturity with respect to culture, leadership, organization, and technology; meaning of digital culture, and adaptability of the culture to digitalization.

4.3 Findings from Interviews

Table 4 presents the findings of the qualitative method based on the 5 semi-structured interviews with a total of 7 themes and several subthemes emerging from the interviews. These themes and subthemes were used for interpreting the findings of the study with regard to the research questions and the study objectives.

Table 4 The themes and subthemes extracted from the 5 interviews.

S/N	Themes	Names of Themes and Subthemes	Names of subthemes
1	Theme 1	Perception of DT	• Leaner processes • Cost effective solution • Target to achieve • Capital intensive • DT is essential

S/N	Themes	Names of Themes and Subthemes	Names of subthemes
2	Theme 2	Place of DT in O&G	• Allows flexibility in operations • GDP mostly depends on O&G • DT Allows operational efficiency • Data analysis is done better with DT • Easier pipeline protection, including safety. • Interconnectivity • Better collaboration • Convenience of access to information
3	Theme 3	Barriers to DT Adoption in O&G	• Cost of instituting DT • Security of data • Hacking • Information loss due to software issues • Employee resistance due to job loss • Poor attention to DT by leaders in O&G • Lack of sufficient resources
4	Theme 4	Digital culture	• Poor digital mindset • General anxiety over digitalization • Culture of digitalization is mild • Culture is partially closed to new ideas • Culture not totally connected to digitalization • Digitalization is on individual basis
5	Theme 5	Business digital platform	• Absence of platform for digitalization • Organizations do not want to share data on any platform • Data is kept privately and not on any external platform • Cost and security of data do not make platform a priority • It is considered ideal for better data safety
6	Theme 6	Digital performance	• Maturity is small with regards to digitalization • Improvement in maturity is slow • The industry is not matured digitally • Several levels and processes still required • Leaders not committed to digital maturity
7	Theme 7	Digitalization & culture	• Mutual understanding with regard to digitalization • Digital transformation is policy driven with culture • Digital transformation is basically an ideal, but not integrated wholly with culture

Theme I – DT Perception

These themes comprised of subthemes such as cost effective solution, leaner processes, better collaboration, capital intensive etc.

DT is generally perceived as a welcome development in the O&G industry in Qatar and therefore interviewers associated it with more positive outcomes such as making the processes in operations leaner, cost effective solution, data tracking for convenience and accessibility etc. However, the interviewees also included that DT was cost intensive if implemented. This seems to play a major role in the implementation of DT in the O&G industry in Qatar and in the globe generally. While during the interviews, the respondents all accepted that DT is essential for effective operations in the industry, they seemed to be weary of its implementation. This may be due to the financial cost of DT implementation as one respondent succinctly highlighted the challenge of its implementation thus:

> *…….it's going to save, it's going to save you money on the long run. So, sometimes, I feel that the management does not look in on the long term goal; they're looking on short, on the short term goals. And you know, when we when we, when we say cost or budget they even, they immediately get alarmed and they get discouraged about changing……*

While DT was reported by the interviewees as a strategy in which O&G activities can be optimized through effective data tracking and a method in which cost can be reduced significantly, they also ascribed the issue of data security as an important factor that may hinder the global popularity of DT in the O&G industry globally. The question is: if DT is essential to O&G operations, why the slow pace of its adoption? The answer to this very important question was provided by the interviewees. They mentioned explicitly that leaders in the industry pay lip service to the implementation of DT due to a number of

reasons. For instance, the leaders in the industry while not doubting the efficacy of DT in bringing about more effective O&G operations indicated that the lingering low prices of O&G product globally discouraged adopting some cost effective solutions such as DT.

Theme II - Place of DT in O&G

The respondents indicated that DT is essential for the industry as it would engender many positive outcomes in operations. Therefore, subthemes such as it allows flexibility in operations, Qatar GDP mostly depends on O&G, DT allows operational efficiency, data analysis is done better with DT, easier pipeline protection, including safety, and interconnectivity resonated among the respondents. The point here is that DT is mostly seen as critical to the improvement of refinery operations even though there is low chance that DT would be implemented company-wide. From the account of one of the respondents, DT is in the incubation stage and that someday, it would be implemented so as to reap its full benefits. More importantly, DT was perceived as one strategy that can lead to better safety of humans and pipelines. An interviewee had this to say regarding the place of DT in O&G industry in Qatar:

> *Designated to identify the solutions to create proof of concepts fundamental but that energy and scale them up if they see that they are effective. So, I think that's the first step that kind of shows that we are looking into digitalising how we do our business. It's just finding the right solution; finding a way to be implemented within our processes. Thereby it is there throughout the day it's just a matter of finalizing it.*

Theme III – Barriers to DT adoption

These themes comprised of the following subthemes: cost of instituting DT, security of data, hacking, information loss due to software issues, employee resistance due to fear of job loss, poor attention to DT by leaders in O&G, and lack of sufficient resources.

Barriers to DT adoption though comprised of many factors as indicated by the subthemes. However, insufficient fund is probably the most consistent reason for not making DT a wide-organizational practice. The interviewers unanimously agreed that the cost of DT is enormous and coupled with the global oil price that is low adopting DT in the industry in Qatar may perhaps take longer than expected. Though interviewees mentioned other factors as highlighted by the subthemes, but cost remains the most salient barriers against DT implementation in the O&G industry. For instance, data security was mentioned as one of the risks preventing DT adoption. This is related to the business platform as subscribing to a digital platform which operations are external might expose their data. Moreover, on specific digital platform, data are shared with others on the platform, which exposes data to many risks.

> *Because sometimes you have digitization platform and there is too much information to influence who was asking for the information. This is most valuable enough to so it may take more than two million dollars to monitor the business. However, this sort of exposes the company's data.*

Theme IV - Digital Culture

The themes included poor digital mindset, general anxiety over digitalization, culture of digitalization is mild, culture is partially closed to new ideas, culture not totally connected to digitalization, and digitalization is on individual basis.

Poor digital mindset implies that digital culture in the industry is relatively low as digitalization is restricted to limited departments or units. In the organization, digital culture is limited to certain activities and management seemed to welcome DT as an idea, but not a practice that resonates in the entire organization. More importantly, leaders are the custodians of organizational culture, but their overt behaviour suggests otherwise when it comes to DT as they flinch at the idea once the cost is being discussed. As per individual basis, digital culture is perceived as ideal and something that should be adopted company-wide. This may be the reason why management romanticise with the idea of DT, but never takes time to adopt as a practice in the entire organization. For instance, one of the respondents had this to say about digital culture in their organization:

> *……possibly cultures are created through decision makers. And then if I have my senior management telling me from tomorrow we're stopping this process in the beginning this process I'm going to do it. It is what it is. It's through them it's a it's a top to bottom ripple effect. Quality of the results encourage your thoughts to make more open culture. You see, even if you do that, if your upper management is not bought in on the idea of digital transformation then there's no point.*

The interviewees also mentioned that culture is not totally linked to digitalization as complete digitalization was limited to refinery operations. Again, it was indicated by the respondents that seeming cost of DT was a strong barrier. Thus, culture of digitalization does not exist in the strict sense of the word. There are still many paper works with regard to data and information transmission in general. This is perhaps more noticeable with regard to safety. This is because the respondents for the interviews were all purposively sampled from the refinery operations of the organization. Therefore, their

focus was on DT in refinery operations and not the entirety of the focal organization. Thus, the culture of digitalization is not completely fostered in the organization and therefore digital culture cannot be said to be totally entrenched, but rather it is implicit.

Theme V – Business Digital Platform

These themes involved absence of platform for digitalization, do not want to share data on any platform, data is kept privately and not on any external platform, cost and security of data do not make platform a priority, and it is considered ideal for better data safety.

The interviewees indicated that there was no business digital platform for their company even though they believe it would make the organization more effective and efficient. This is probably due to the unwillingness of the organization to share data on any business platform. Respondents recognized the importance of the organization hosting its data on a business digital platform such as Bizagi's new Experience Designer. However, management perhaps did not deem it fit even though the idea is often mooted by the leaders in the organization. Moreover, respondents were uncertain if in the future leaders would favor hosting their data on a business platform. Though the cost of hosting the data on business digital platform was very strong just as preventing data breach as the basis for not having a business plan where data can be hosted. Further questioning on the benefits of digital business platform generated positive perception such as data safety, convenience of data storing and retrieval for documenting safety issues.

> *……because sometimes you have digitization platform and there is too much information to influence your decision or data. This is most expensive and therefore you may need to spend two million dollars to monitor your business. And we need a good*

experience and powerful tool to make your chosen business platform up to speed.

Theme VI – Digital Performance

These themes consisted of maturity is small with regards to digitalization, improvement in maturity is slow, the industry is not matured digitally, several levels and processes still required to be digitally matured, and leaders are not committed to digital maturity.

They understood digital maturity as reaching complete digital operation in all their activities within the organization. The result of the qualitative phase of the study also revealed that the level of maturity in O&G industry is mild and therefore system and processes are still managed to some extent non-digitally. When asked why an industry as powerful as O&G does not operate fully digitally in Qatar. The response which resonated among the respondents was that the cost of reaching digital maturity is expensive. But they seemed to express the optimism that gradually they would reach digital maturity. They perceived the digitalization of the refinery operations as the true test of their road to digital maturity. In addition, there is the belief that the road to digital maturity was not as fast as they probably wish. Therefore, improvement in digital maturity was noted to be dismal as leaders often cite cost ass the main barrier. The slow pace of digital maturity may not be unconnected with the same slow pace of digitalization in O&G industry in general. During one of the interviews, a respondent said this:

We have tools and all the knowledge that we need to implement, assess, and develop to reach a digital maturity. But we shall get there one day. Look at the banking industry, they are better in terms of maturity.

The respondents indicated that the processes involved in being digitally matured are many and that they have not passed the entire processes for the O&G industry in Qatar. They understand that there are more levels that they must attain. Though from their responses, what

resonated with regard to maturity processes and whether their organization has passed some levels that are critical for DT was one of dim hope as they continue to mention that the leaders are the decision makers and if they did not have positive attitude towards DT, reaching digital maturity might be more difficult than they thought. One respondent revealed that there mere mention of cost regarding DT made their leaders to shiver. Thus, achieving digital maturity by the O&G in Qatar may be later rather than sooner. A respondent had this to say regarding digital maturity and DT:

> *Yeah yeah I'm going see that, now I'm a manager and I don't want to spend more on the things that are not. Let's see that those that are being done without having to spend one more dollar. For example, this tracking and safety equipment and safety items within the refinery operations. A former manager visit you don't want to it's already being done what do I need to spend more on on resources and money to have something just to make things look better*.

Theme VII – Digitalization and Culture

The following subthemes emerged from this theme: mutual understanding with regard to digitalization, digital transformation is policy driven with culture, digital transformation is basically an ideal, but not integrated wholly with culture.

This theme involved how respondents saw the connection between the organizational culture and digitalization with regard to DT. Though respondents understood organizational culture and insisted it was their leaders who developed the culture and passed it around to the employees, but with regard to digitalization, they were of the belief that digitalization was more of individual thing and which is difficult to achieve across the organization. Thus, any linkage between the culture of the organization and digitalization seems to be somehow elusive. This is probably because the leaders who created the culture through different policies and values

of the organization have not given the same attention to digitalization. The leaders themselves are of the opinion that digitalization is essential for smooth refinery operations, but they explicitly view the cost implications as strong barriers. Thus, the link between digitalization, DT, and culture is not obvious. Again, the leader themselves viewed digitalization, DT, and culture leakage as an ideal, but not what is worth attaining in the nearest future.

> *…….of course I'm going say that it's better to have it in my own business. It's less time consuming I can organize myself against certain goals based on live data is the same thing for this and safety equipment. It's much better for the put it to the whole and call any personnel to help to collect data of all the equipment.*

4.4 Summary of Qualitative Findings

Since the research was mixed method and adopted the sequential method, the findings from the qualitative and quantitative phases must be integrated in this section of this report. The result showed digital transformation is critical to the performance of the oil and gas sector in Qatar. The findings of the study highlighted the more critical factors that affected digital transformation in the oil and gas industry. In the qualitative phase, it was revealed that the major issue preventing the O&G industry in Qatar from gaining the benefits of DT was the cost of instituting such policy. Though the refinery operation was noted to be digitalized in all ramifications, but this was not extended to the entire downstream sector and there seems not to be plans to institute DT in the entire organization.

In addition, the leaders in the organization despite accepting the necessity of DT in today's organization, they did not express much optimism in ensuring DT spread across the entire operations in the O&G industry in Qatar. Moreover, digital culture and digital maturity are said to be critical to adopting DT in the O&G industry. Yet, acceptance of digital culture was relatively low and circumscribed to specific activities and operations and therefore the digital culture is limited. It was shown also that the O&G industry in Qatar and globally too, has not matured digitally as many activities in marketing, management of people, technology, and other dimensions of digital maturity are relatively low.

4.5 Quantitative Findings

Table 5 Socio-demographic characteristics of respondents

Variable	Category	Frequency	Percent
Gender	Male	115	76.7%
	Female	35	23.3%
Age	21-23	25	16.7%
	24-26	83	55.3%
	27-29	17	11.3%
	30-33	19	12.7%
	34-36	6	4.0%
Current department in the organization	Production	32	21.3%
	Maintenance	23	15.3%
	Business Support	66	44.0%
	Asset Integrity	16	10.7%
	Safety	13	8.7%
Current job position in the organization	Employee	83	55.3%
	Frontline	23	15.3%
	Middle Management	36	24.0%
	Top Management	8	5.3%
Work experience in the current organization	1-2	29	19.3%
	3-4	25	16.7%
	5-6	29	19.3%
	7-8	18	12.0%
	9-10	5	3.3%
	11-12	9	6.0%
	13-14	9	6.0%
	15-16	3	2.0%
	17-18	3	2.0%
	19-20	4	2.7%
	More than 21 years	16	10.7%
Highest level of education	Primary School	4	2.7%
	Secondary School	7	4.7%
	Vocational School	6	4.0%
	University	133	88.7%
	Total	150	100.0

The distribution of respondents reveals that males (76.7%) constituted more than two-third of the respondents 23.3%% were females. The age distribution shows that a greater significant proportion of the respondents (55.3%) were of age 24 - 26 years, 16.7% were in 21 - 23 year age group, followed by 12.7% who are in the 30 -33 years age group, 11.3% were of the age group of 27 - 29 years and 6% were 34 – 36 years age group. The current department the respondents belong to include production (21.3%), maintenance (15.3%), business support (44.0%), asset integrity (10.7%), and safety (8.7%) departments. Current job position in the organization include respondents shows that they are majorly employees (55.3%), frontline (15.3%), middle management (24.0%) and top management (5.3%).

Furthermore, years of experience frequency intervals showed that significant number of employees have spent 1-2 years (19.3%) and 5- 6 years (19.3%). The distribution also showed that some of the employees have spent 3 – 4 years (16.7%), 7-8 years (12.0%), 9-10 years (3.3%), 11-12 years (6.0%), 13-14 years (6.0%), 15-16 years (2.0%), 17-18 years (2.0%), 19-20years (2.0%), 21 years or more (10.7%) on the job. The respondents were largely graduates with first degree qualification (88.7%), while others have primary school education (2.7%), secondary school education (4.7%), and vocational education (4.0%).

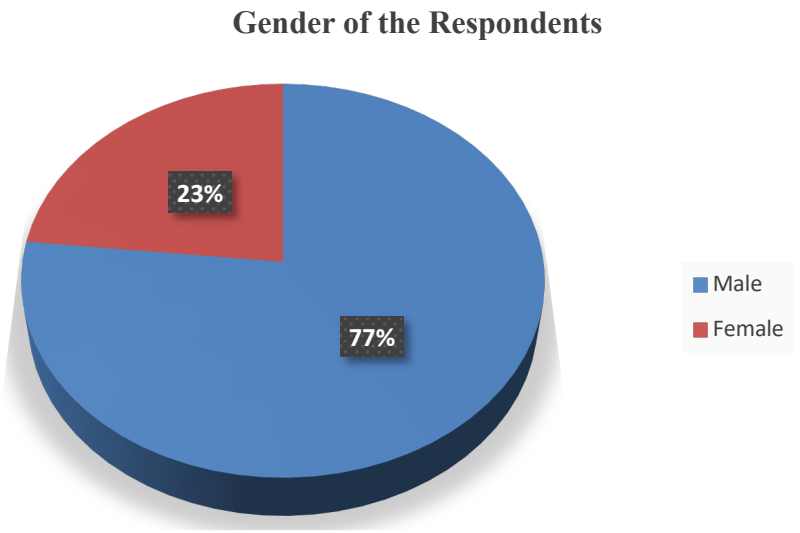


Figure 6. Pie chart showing the distribution of respondents based on gender

Males constituted the major and dominant gender in the study as well as the organisation studied compared to the females.

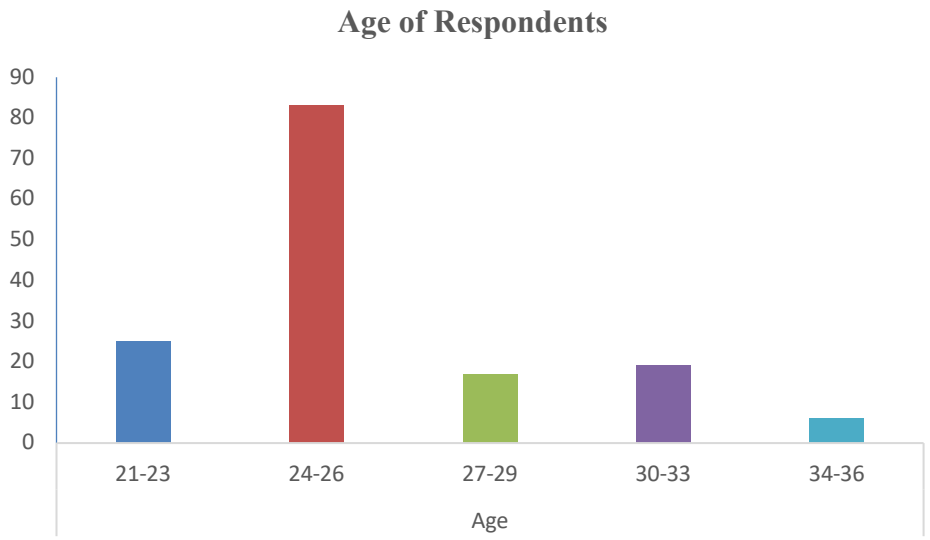


Figure 7. Bar chart showing the distribution of respondents based on age

The age distribution shows that a greater significant proportion of the respondents were of 24 - 26 years, 21 - 23 year and 30 -33 years age group.

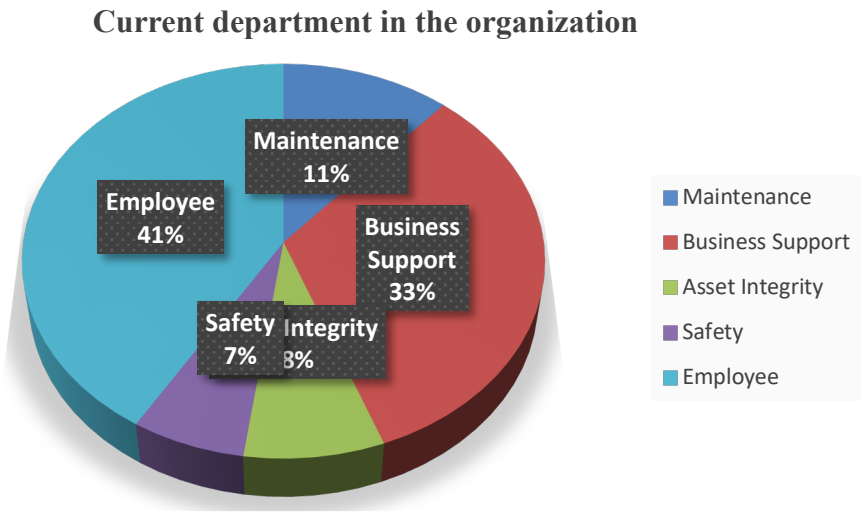


Figure 8: Pie chart showing the distribution of respondents based on department

The current department the respondents belong to include production, maintenance, business support, asset integrity, and safety departments.

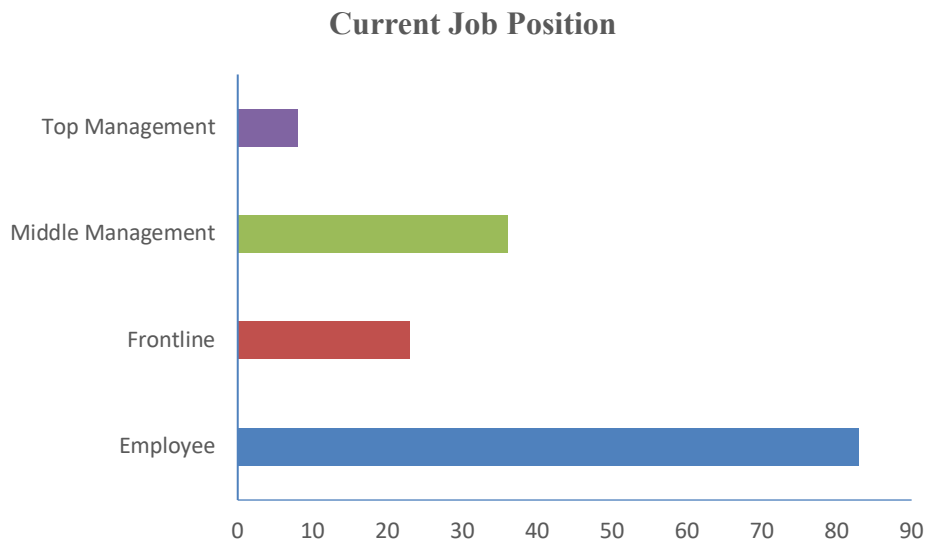


Figure 9. chart showing the level of management respondents

Current job position in the organization include respondents shows that they are majorly employees, frontline, middle management, and top management.

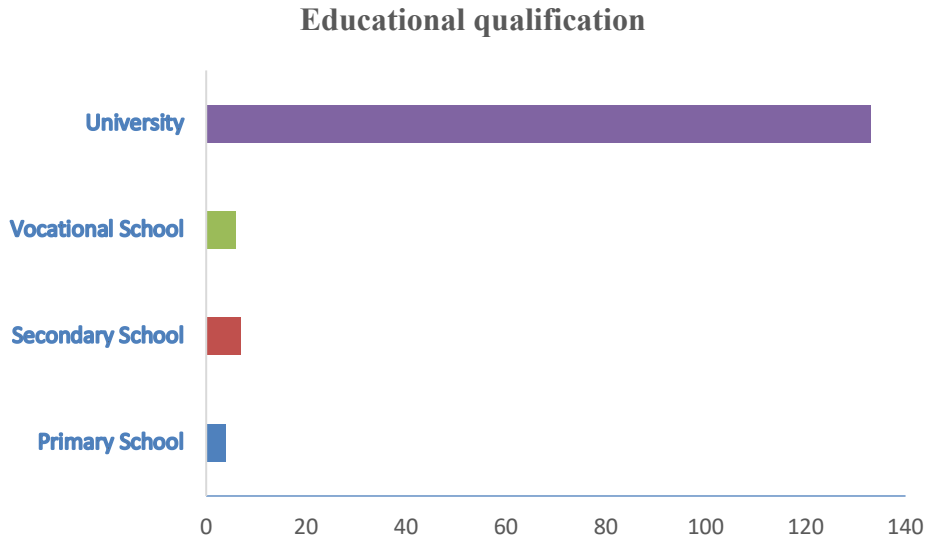


Figure 10. Chart showing the level of education

The respondents were largely graduates with first degree qualification, while others have primary school education, secondary school education and vocational education.

4.4.1 Measurement model

Several fit indices have been proposed and utilised by previous researchers to assess the overall fit of the measurement model prior to arriving at the final factor loadings. To assess the overall fit of the model, the current study employed goodness of fit (GFI), comparative fit index (CFI) as proposed by Hu and Bentler (1999), the 2 (chi-square)/df (degrees of freedom) ratio (Bollen, 1989), Incremental fit index (IFI) (Bollen, 1989), and root mean square error of approximation (RMSEA). Confirmatory factor analysis was used to establish items that have a good model data fit. The stronger model fit indexes (CFI = 0.984, RMSEA = 0.062), than the original model (CFI = 0.702) before five items were deleted for poor loading. The model fitness showed an acceptable fit:χ^2=2110.199,652 degrees of freedom, p=0.00; CFI=0.98; AGFI = 0.96; IFI= 0.97; TLI = 0.96; RMSEA= 0.062 (90% confidence interval .03 -.128), and SRMR = 0.05).

Table 6 Factor loadings and composite reliabilities of the items measuring the variables

		Perceived risk	Perceived opportunity	Digital organizational culture	Digital Transformation	Digital Maturity
Perceived Risk		0.846				
Perceived Risk		0.776				
Perceived Risk		0.753				
Perceived Risk		0.722				
Perceived Opportunity			0.962			
Perceived Opportunity			0.966			
Perceived Opportunity			0.913			
Perceived Opportunity			0.800			
Digital organizational culture				0.677		
Digital organizational culture				0.857		
Digital organizational culture				0.676		
Digital organizational culture				0.801		
Digital Maturity	Strategy				0.864	
Digital Maturity	Strategy				0.914	
Digital Maturity	Strategy				0.78	
Digital Maturity	Strategy				0.841	
Digital Maturity	Leadership				0.869	
Digital Maturity	Leadership				0.917	
Digital Maturity	Leadership				0.881	
Digital Maturity	Leadership				0.742	

		Perceived risk	Perceived opportunity	Digital organizational culture	Digital Transformation	Digital Maturity
Digital Maturity	Marketing				0.761	
Digital Maturity	Marketing				0.799	
Digital Maturity	Marketing				0.818	
Digital Maturity	Operation				0.803	
Digital Maturity	Operation				0.813	
Digital Maturity	Operation				0.811	
Digital Maturity	People				0.805	
Digital Transformation	Customers experience					0.801
Digital Transformation	Customers experience					0.891
Digital Transformation	Customers experience					0.675
Digital Transformation	Customers experience					0.642
Digital Transformation	Operational efficiency					0.801
Digital Transformation	Operational efficiency					0.935
Digital Transformation	Operational efficiency					0.713
Digital Transformation	Operational efficiency					0.792
Digital Transformation						0.991
Digital Transformation						0.834
CR		0.812	0.942	0.828	0.99	0.997
AVE		0.592	0.803	0.819	0.971	0.984
MSV		0.357	0.608	0.78	0.75	0.723
MaxR(H)		0.834	0.966	0.842	0.976	0.922

Notes: CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance; MaxR(H) = maximum reliability; (H) and † = square root of AVE.

4.4.2 Reliability

The composite reliability (CR) of each scale is calculated as the norm for analyzing the reliability of the constructs proposed by Fornell and Larcker (1981). Table 2 shows the reliability estimates using the CR criterion based on the loadings in the measurement model. This criterion provides a more robust measure of scale reliability than the traditional Cronbach's alpha. Fornell and Larcker (1981) regard structures with composite reliabilities better than 0.80 to be suggestive of good dependability. The composite reliabilities of all variables were significantly above the Fornell and Larcker (1981) threshold and exceeded the 0.8 value in all cases, suggesting that each dimension was extremely reliable. Furthermore, good composite reliabilities of constructs are an indicator of good convergent validity (Fornell & Larcker, 1981). The fact that the composite reliabilities of all constructs exceeded the cutoff value of 0.80 supports the convergent validity.

Table 7: Convergent Validity and Discriminant Validity

	CR	AVE	MSV	MaxR(H)	Perceived risk	Perceived opportunity	Digital organizational culture	Digital Transformation	Digital Maturity
PR	0.812	0.592	0.357	0.834	0.769				
PO	0.942	0.803	0.608	0.966	-0.597***	0.896			
DOC	0.828	0.819	0.780	0.842	-0.394***	0.780***	0.799		
DIGTRANSFORM	0.990	0.971	0.750	0.976	-0.272**	0.740***	0.866***	0.986	
DIGITALMATURITY	0.997	0.984	0.723	0.922	-0.284**	0.629***	0.761***	0.850***	0.992

† p< 0.100, * p < 0.050, ** p < 0.010, *** p < 0.001

Notes: CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance;

MaxR(H) = maximum reliability; (H) and † = square root of AVE.

The Fornell and Larcker (1981) criterion was used to assess the convergent validity of various components of organizational capital. If the average variance extracted (AVE) for each element exceeds the value of 0.50, this criteria indicates that the dimensions of a measurement model have excellent convergent validity. This cutoff or threshold denotes that the latent concept should account for more variance in the associated indicators than measurement errors. All of the constructs studied had an AVE greater than 0.50, which was the cutoff value. The inter factor correlations are shown in the table as diagonal entries. This shows that convergent validity is not a problem.

Table 8: Means, standard deviations, and correlations

	N	Minimum	Maximum	*M*	*SD*	Skn	Kurt	Bivariate correlations 1	2	3	4	5
1. Digital Transformation	150	12.00	50.00	32.17	7.95	-.25	-.46	--				
2. Perceived Risk	150	4.00	20.00	11.93	3.57	-.06	-.51	-.20*	--			
3. Perceived Opportunity	150	4.00	20.00	13.25	5.11	-.43	-1.20	.69**	-.50**	--		
4. Organizational Digital Culture	150	4.00	20.00	12.99	3.61	-.33	-.35	.74**	-.24**	.70**	--	
5. Digital Maturity	150	24.00	89.00	60.11	14.83	-.21	-.60	.80**	-.22**	.64**	.71**	--

4.4.3 Preliminary Analyses

Descriptive statistics and correlation of study variables are shown in Table 4. Results indicated that asymmetry ranged from −.34 to .1.06 and kurtosis ranged from −.1 to .52 which were within the criteria of normality, and goodness-of-fit indices of ($\chi 2$ (14, N = 150) = 5.88; p =.015; $\chi 2$/df = 5.88; GFI = .99; CFI=. 99; IFI = .99, NFI = .99; TLI = .89; SRMR = .081; RMSEA = .18 [HI=.06-LO=.33]. The correlation values were calculated using structural equations method (SEM). Perceptions of digital transformation was positively associated with

digital maturity ($r = .80$, $p < .01$). Perceived risk was negatively associated with digital maturity ($r = -.20$, $p < .01$), and perceptions of digital transformation ($r = -.22$ $p < .01$). Perceived opportunity ($r = .69$, $p < .01$) and digital organizational culture ($r = .74$, $p < .01$) were also significantly associated perceptions of digital transformation. Likewise, perceived opportunity ($r = .64$, $p < .01$) and digital organizational culture ($r = .71$, $p < .01$) were also significantly correlates of digital maturity. Perceived risk was demonstrated to correlate significantly with perceived opportunity ($r = -.50$, $p < .01$) and digital organizational culture ($r = -.24$, $p < .01$).

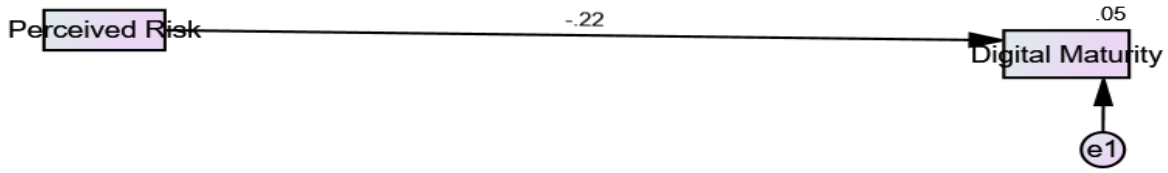
4.4.4 Test of hypotheses

Hypothesis 1:

There would be a positive association between perceived risk (PR) and digital maturity (DM).

Table 9: Path analysis of perceived risk as predictors of Perceptions of digital maturity model

			Estimate	S.E.	C.R.	*p*	*β*	R^2
Digital maturity	<---	Perceived risk	-.898	.332	-2.703	.007	.073	.047



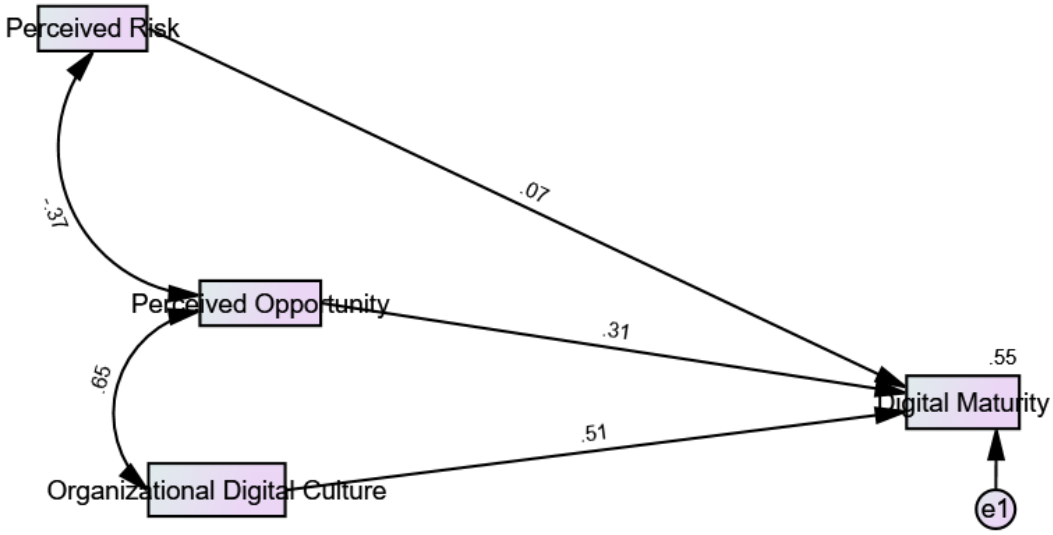
Model of Perceived risk as Factor influencing Perception of Digital Maturity in The Oil & Gas Industry in The State of Qatar
Chi square =.000, df=0, p=\p
GFI=1.000,AGFI=\agfi, CFI=\cfi, TLI=\tli,
RMSEA=\rmsea,RMR = \rmr, HI=\rmseahi - LO=\rmsealo
SRMR = .000

The hypothesis was tested initially in combination with other independent variables and found that the values of the association of perceived risk and digital maturity was mediated by the inclusion of other independent variables. Thus, a single direct path between was conducted

excluding variables of perceived opportunity plus digital culture and found that perceived risk and digital maturity (DM). (β= .25; t = -2.70; p< .01) had significant inverse associations. The hypothesis was thus supported.

For hypotheses 2 and 3

The path analysis of the 3 independent variables was retained. The model levels of goodness-of-fit indices: (χ2 (14, N = 150) = 5.88; p =.015; χ2/df = 5.88; GFI = .99; CFI=. 99; IFI = .99, NFI = .99; TLI = .89; SRMR = .081; RMSEA = .18 [HI=.06-LO=.33].



Model of Force Factors influencing Perception of Digital Maturity in The Oil & Gas Industry in The State of Qatar
Chi square =9.179, df=1, p=.002
GFI=.971,AGFI=.710, CFI=.969, TLI=.814,
RMSEA=.234,RMR = 3.826, HI=.383 - LO=.113
SRMR = .1047

Table 10: Path analysis of predictors of Perceptions of digital transformation model

			Estimate	S.E.	C.R.	*p*	*β*
Digital Transformation	<---	Perceived opportunity	.957	.253	3.787	***	.314
Digital Transformation	<---	Digital organizational culture	2.064	.314	6.565	***	.506
Digital Transformation	<---	Perceived risk	.300	.260	1.154	.249	.073

Hypothesis 2:

Hypothesis 2: There would be a positive association between perceived opportunity (PO) and digital maturity (DM). The result demonstrated that a significant association existed between perceived opportunity (PO) and digital maturity (DM) (β= .31; t= 3.79; p< .001) in the model. The hypothesis was therefore supported.

Hypothesis 3*:*

Hypothesis 3: There would be a positive association between digital organizational culture (DOC) and digital maturity (DM). The results revealed that digital organizational culture (DOC) and digital maturity (DM) had significant positive direct association in the model (β= .51, t= 6.57, p< .001). The hypothesis was thus supported.

Hypothesis 4: digital maturity (DM) would mediate the relationship between digital culture and digital transformation (DT)

The model was tested in two ways. First the result included the paths from the independent variables (perceived risk, perceived opportunity, and digital organizational culture) as predictors of the mediator (digital maturity) (Path A) as well as the direct paths to the dependent variable (Digital transformation) (Path c). Also, the direct path from the mediator (Path B) to the dependent variable (Digital transformation) was included in the model.

4.4.5 Direct path Preliminary Analyses Model

Table 11: Path analysis of perceived risk as predictors of perceptions of digital transformation model

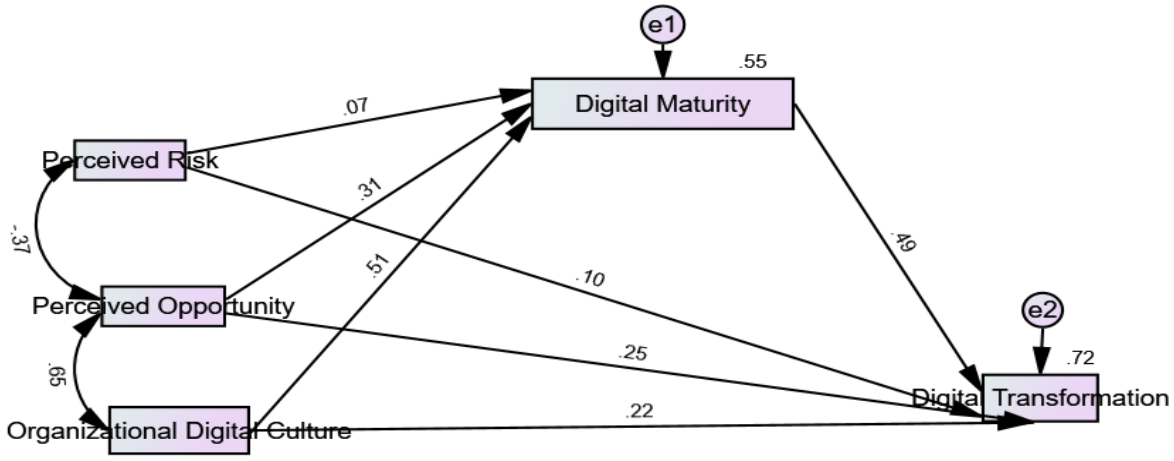
			Estimate	S.E.	C.R.	*p*	*β*	R^2
Digital organizational culture	<--	Perceived risk	-.247	.080	-3.077	.002	-.244	.060
Digital maturity	<--	Perceived risk	-.898	.332	-2.703	.007	.073	.047
Digital maturity	<--	Perceived opportunity	1.870	.182	10.297	***	.645	.416
Digital transformation	<--	Perceived opportunity	1.071	.092	11.609	***	.689	.475
Digital transformation	<--	Digital organizational culture	1.621	.122	13.247	***	.735	.541
Digital transformation	<--	Digital maturity	.430	.026	16.415	***	.802	.644

			Estimate	S.E.	C.R.	*p*	*β*	R^2
Digital transformation	<--	Perceived risk	-.438	.179	-2.450	.014	-.197	.039

The initial model for the path from the independent variables to the dependent variables before the mediators and other variables were included in the various model. Perceived risk was demonstrated to have significant association with digital organizational culture (DOC) (*β*= -.24; t= -3.08; *p*< .01); digital maturity (DM) (*β*= .07; t= -2.70; *p*< .05); and digital transformation (*β*= -.20; t= -2.45; *p*< .05). Perceived opportunity significantly predicted digital maturity (DM) (*β*= .65; t= 10.30; *p*< .001) and digital transformation (*β*= .69; t= 11.61; *p*< .001). Digital organizational culture (DOC) predicted digital maturity (DM) (*β*= .80; t= 13.25; *p*< .001), but digital maturity (DM) did not predict perceived risk (*β*= -.20; t= =2.42; *p*> .05).

4.4.6 The Mediation Model I

The mediatory model demonstrated a mediocre fit values: (χ2 (1, N= 150) = 9.18; *p* = .92; χ2/df = 9.18; GFI = .98; AGFI = .65; CFI = .98; NFI = .98; TLI = .82; SRMR = .097; RMSEA = .23[HI=.38-LO=.11]). The covariance of perceived opportunity with perceived risk and that of digital organizational culture with perceived opportunity were controlled. The covariance of perceived risk and digital organizational culture was trimmed due to negative error contributions to the model.



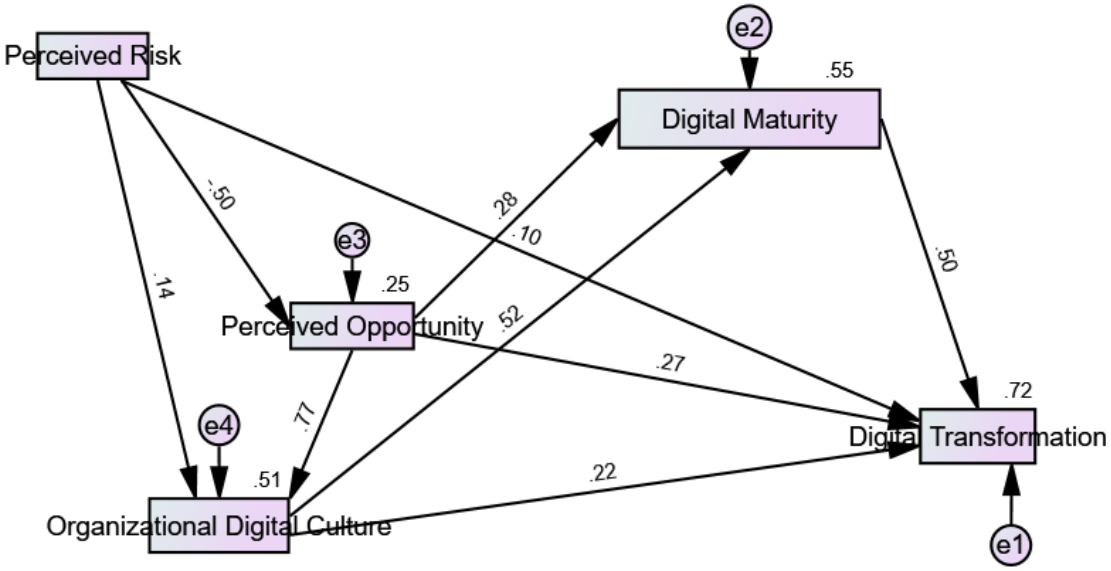
Model of Force Factors influencing Perception of Digital Transformation in The Oil & Gas Industry in The State of Qatar
Chi square =9.179, df=1, p=.002
GFI=.977,AGFI=.650, CFI=.982, TLI=.818,
RMSEA=.234,RMR = 3.470, HI=.383 - LO=.113
SRMR = .097

Table 12: Path analysis of the role of force factors and digital maturity as mediator in the Perceptions of digital transformation model

			Estimate	S.E.	C.R.	*p*	*β*	R^2
Digital maturity	<---	Perceived risk	.300	.260	1.154	.249	.073	
Digital maturity	<---	Perceived opportunity	.957	.253	3.787	***	.314	.549
Digital maturity	<---	Digital organizational culture	2.064	.314	6.565	***	.506	
Perceptions of digital transformation	<---	Digital maturity	.266	.035	7.663	***	.494	
Perceptions of digital transformation	<---	Digital organizational culture	.483	.151	3.194	.001	.220	.721
Perceptions of digital transformation	<---	Perceived opportunity	.411	.112	3.673	***	.251	
Perceptions of digital transformation	<---	Perceived risk	.216	.111	1.953	.051	.097	

The result demonstrated that a significant association existed between perceived opportunity (PO) (β= .31; t= 3.79; p< .001), digital organizational culture (DOC) (β= .51; t= 6.57; p< .001), and digital maturity (DM) while digital maturity association with perceived risk was not significant. Digital maturity mediated the values of the relationship among perceived opportunity (PO) (β= .25; t= 3.67; p< .001), digital organizational culture (DOC) (β= .22; t= 3.19; p< .001) and perceptions of digital transformation, while perceived risk relationship with perceptions of digital transformation was weak. Digital maturity had significant positive association with perceptions of digital transformation (β= .22; t= 3.19; p< .001). A partial mediation occurred as the coefficient reduction in beta weight 6% and 9% respectively for perceived opportunity and digital organizational culture. Due to the poor fit, a new model was tested wherein perceived opportunity and digital organizational culture as possible mediator of perceived risk leading to improvement in the model. In addition, the role of digital organizational culture as possible mediator of perceived opportunity was also included in the new model.

4.4.7 The Mediation Model II



Multiple Mediator Model of Force Factors influencing Perception of Digital Transformation in The Oil & Gas Industry in The State of Qatar
Chi square =1.264, df=1, p=.261
GFI=.997,AGFI=.949, CFI=.999, TLI=.994,
RMSEA=.042,RMR = .757, HI=.227 - LO=.000
SRMR = .015

Table 13: Path analysis of the factors and digital maturity as mediator in the Perceptions of digital transformation model

			Estimate	S.E.	C.R.	*p*	*β*	R^2
Perceived opportunity	<--	Perceived risk	-.720	.101	-7.100	***	-.503	.253
Digital organizational culture	<--	Perceived risk	.145	.067	2.160	.031	.144	
Digital organizational culture	<--	Perceived opportunity	.545	.047	11.59	***	.772	.506
Digital maturity	<--	Perceived opportunity	.820	.223	3.684	***	.283	.552
Digital maturity	<--	Digital organizational culture	2.127	.316	6.732	***	.517	
Perceptions of digital transformation	<--	Digital maturity	.266	.035	7.695	***	.497	
Perceptions of digital transformation	<--	Digital organizational culture	.411	.111	3.717	***	.265	.721
Perceptions of digital transformation	<--	Perceived opportunity	.483	.154	3.137	.002	.220	
Perceptions of digital transformation	<--	Perceived risk	.216	.113	1.916	.055	.097	

The result in Table 9 demonstrated that a significant association existed between perceived opportunity (PO) and perceived risk (β= .50; t= -7.10; p< .001). In the second model, it was demonstrated that perceived opportunity mediated the associations between perceived risk and digital organizational culture (β= .14; t= -2.16; p< .001) initial (β= .24; t= -3.08; p< .001) a suppression of 41.6% in its original value. The association between perceived opportunity and digital organizational culture (β= .77; t= 11.59; p< .001) was significant confirming a partial mediation. From the second model, the second mediation model tested

showed that digital organizational culture and perceived opportunity were associated and organizational culture was demonstrated to mediate the association of perceived opportunity with digital maturity (β= .28; t= 3.68; p< .001; initial (β= .65; t= 10.30; p< .001), a suppression of 56.9% in its original value.

Furthermore, the association between digital organizational culture and digital maturity (β= .52; t= 6.73; p< .001) was significant confirming a partial mediation. Finally, the associations of perceived opportunity (β= .22; t= 3.68; p< .001; initial (β= .69, t= 13.25, p< .001) and digital organizational culture (β= .028; t= 3.68; p< .001; initial (β= .74; t= 10.30; p< .001) with digital transformation was significantly mediated by digital maturity. Digital maturity had significant positive association with perceptions of digital transformation (β= .50; t= 7.70; p< .001). A partial mediation occurred as the coefficient reduction in beta weight 6% and 9% respectively for perceived opportunity and digital organizational culture. Due to the poor fit, a new model was tested wherein perceived opportunity and digital organizational culture as possible mediator of perceived risk leading to improvement in the model. In addition, the role of digital organizational culture as possible mediator of perceived opportunity was also included in the new model.

Table 14: Bootstrapped indirect path of moderators and mediator of perceived risk

Indirect Path	*b*	Lower	Upper	P-Value	*β*
Mediator: Perceived opportunity					
Perceived risk --> Perceived opportunity --> Organization digital culture	-0.392	-0.493	-0.293	0.001	-0.388***
Perceived risk --> Perceived opportunity --> Digital maturity	-0.590	-0.970	-0.192	0.017	-0.142*
Perceived risk --> Perceived opportunity --> Digital Transformation	-0.296	-0.516	-0.116	0.006	-0.133**
Mediator: Organization digital culture					
Perceived risk --> Organization digital culture --> Digital maturity	0.309	0.077	0.658	0.030	0.074*
Perceived risk --> Organization digital culture --> Digital Transformation	0.070	0.015	0.177	0.027	0.032*
Perceived opportunity --> Organization digital culture --> Digital maturity	1.158	0.804	1.659	0.000	0.399***
Perceived opportunity --> Organization digital culture --> Digital Transmission	0.263	0.106	0.405	0.009	0.170**
Mediator: *Digital maturity*					
Perceived opportunity --> Digital maturity --> Digital Transformation	0.218	0.081	0.366	0.012	0.141*
Organization digital culture --> Digital maturity --> Digital Transformation	0.565	0.336	0.868	0.001	0.257***
Serial mediation					
Perceived opportunity and Digital maturity					
Perceived risk --> Perceived opportunity --> Digital maturity --> Digital Transformation	-0.157	-0.273	-0.066	0.009	-0.142**
Perceived opportunity and Organization digital culture					
Perceived risk --> Perceived opportunity --> Organization digital culture --> Digital maturity	-0.834	-1.290	-0.557	0.000	-0.388***
Perceived risk --> Perceived opportunity --> Organization digital culture --> Digital maturity --> Digital Transformation	-0.222	-0.386	-0.128	0.000	-0.388***
Perceived risk --> Perceived opportunity --> Organization digital culture --> Digital Transformation	-0.189	-0.321	-0.084	0.006	-0.388**
Organization digital culture and Digital maturity					
Perceived risk --> Organization digital culture --> Digital maturity --> Digital Transmission	0.082	0.022	0.194	0.024	0.074*
Perceived opportunity --> Organization digital culture --> Digital maturity --> Digital Transformation	0.308	0.179	0.502	0.001	0.399***

As seen in Table 10, some of the indirect effects with trajectory coefficients were considered significant, across the range of lower and upper limit values it was not zero for all these results were significant. The estimated confidence interval does not contain zero, or zero did not fall between the resulting confidence intervals. The direct effects of perceived risk on digital organizational culture, digital maturity and digital transformation were partially mediated by perceived opportunity. In addition, the direct effects of perceived risk on digital maturity and digital transformation were partially mediated by digital organizational culture. Further, the path from perceived opportunity and digital organizational culture to digital transformation was partially mediated digital maturity. Serially, perceived opportunity and digital maturity mediated the path from perceived risk to digital transformation. In addition, the path from perceived risk to digital maturity and digital transformation was partially mediated by perceived opportunity and digital organizational culture. The path from perceived risk and perceived opportunity to digital transformation partially mediated digital organizational culture and digital maturity. Thus, the hypothesis was fully supported.

4.4.8 Summary of Quantitative Results

Table 15: Summary of Quantitative Findings

S/N	Groups	Dependent variable	Moderator	Mediator	Support
1	PR		DM		
2	PO	DT			
3	ODC		DM		
4	PO		DM		
5	PR			ODC	
6	PO			ODC	
7	PR	DT	DM	ODC	
8	PO	DT	DM	ODC	

The results of the quantitative showed that there was significant inverse association between perceived risk (PR) and digital maturity (DM). There was a significant association between perceived opportunity (PO) and digital maturity (DM) in the model thereby suggesting the saliency of DM and perceived opportunity (PO) in digital transformation (DT) in the O&G industry. In addition, digital organizational culture (DOC) and digital maturity (DM) had significant positive direct associations in the model. Perceived risk (PR) was shown to have significant association with digital organizational culture (DOC), digital maturity (DM) and digital transformation (DT). Perceived opportunity significantly predicted digital maturity (DM) and digital transformation (DT). Digital organizational culture (DOC) predicted digital maturity (DM) and digital transformation (DT). A partial mediation occurred as the coefficient reduction in beta weight for perceived opportunity and digital organizational culture.

CHAPTER 5: DISCUSSION

5.1 Introduction

This part consists of the in-depth discussion of the findings of the study with evidence to support the result from the literature. The findings of the study gave more impetuous to the criticality of digital transformation in the O&G industry and the saliency of perceived opportunity, perceived risk, and digital organizational culture.

5.2 Discussion

The finding from the quantitative research showed that there was significant negative association between perceived risk and digital maturity. This result implies therefore that the higher the perceived risk, the lower the digital maturity. Digital maturity is considered highly in the O&G industry. In the qualitative finding, it was stated that the digital maturity of the O&G industry was low compared to sectors such as banking, IT etc. This finding corresponded with the result obtained in the quantitative phase of the study which found that perceived risk had inverse relationship with digital maturity. The more compelling justification for perceived risk being inversely related to digital maturity can be observed from the finding of qualitative method which indicated that perceived risk played major role in the negative perception of the need to become digitally matured among the leaders and employees in the O&G industry in the State of Qatar. Basically, the major barrier to digital maturity is the cost of attaining such level of digitalization in the O&G industry. A fact further buttressed by (Tung et al., 2020) who suggested that complete digitalization was limited to refinery operation as majority of the organizations in the industry could not afford the cost. In addition, Tung et al., (2020) indicated that it was only those big organizations in the industry that were able to digitalize their entire refinery operations.

On the basis of this finding, perceived risk was demonstrated to contribute negatively to adoption of digital maturity. This result is in consonance with the activities in the O&G industry in the State of Qatar. In an industry that perceives that being digitally matured would lead to high cost of operations, risk is thus associated with negative consequences such as the cost of digitally maturing digitally or fear of digital maturity as it may be perceived to lead to job loss among employees. Thus, while the employees abhor the fear of job loss due to digital maturity, the leaders on the other hand were afraid of the cost inherent in digital maturity with regard to financial implications of advancing towards digital maturity.

Past empirical research (Rossmann, 2018; Kane et al., 2017) can be marshalled to support the finding of the current research. For instance, for the O&G industry in Qatar to be digitally matured requires that they improve their marketing, operations, possess strong culture, and strong and effective leadership. However, since high perceived risk is inimical to digital maturity as it was demonstrated to be inversely related to digital maturity, the industry continues to lag behind sector such as banking with respect to digitalization and digital transformation.

The result of the study through the qualitative phase revealed that while DT is considered critical for the improvement of the O&G industry, the leaders in the sector are yet to give the much consideration that it requires. In other words, the general perception of DT is positive both from leaders and their staff. However, this is where it stops as there is no concrete platform to make digital transformation transcend the refinery operations. With regard to the quantitative research findings, it was found that perceived risk, perceived opportunity, and digital organizational culture significantly related to digital transformation. However, perceived risk did not only have a weak relationship with digital transformation, but that the association was also negative. The explanation for this might be found in the result of the

qualitative research which suggested that risk was a major issue in why DT has not been practiced across the O&G industry in Qatar.

Prior studies (e.g., Wang et al., 2016; Muller et al., 2018) have reported finding the negative effect of perceived risk on digital outcomes. They explained that when risk involved in performing the task was high, it was likely that it discourages the adoption of the technology. Other researchers (Al-Azba, 2022; et al., 2014; Hagberg et al., 2016) have also given credence to this assertion suggesting that the higher the risk of performing the digital task, the lower the digital performance. It was revealed through the findings of the qualitative research that the leaders in the O&G expressed anxiety over digital transformation with cost of implementing digital transformation being one of the strong barriers. This is probably why unlike perceived opportunity and digital organizational culture, perceived risk was negatively related to digital transformation. It is also necessary to point out the same perceived risk with regard to the cost of instituting digital transformation according to Tung et al., (2020) globally affects the O&G industry. In view of this finding, perceived opportunity and digital organizational culture are the enablers of digital transformation in the O&G industry in Qatar. However, it should be noted that the study found perceived risk as critical to digital transformation, but that it was inversely related to digital transformation. Thus, the second research question and hypothesis were both strongly supported.

It was revealed through the test of the second hypothesis that there was a significant positive association between perceived opportunity and digital maturity based on the hypothesized and tested models. This result implies that the more the perceived opportunity the higher the digital maturity and therefore the hypothesis was accepted. This result was also corroborated by the finding in the qualitative phase of the study. In the qualitative research, it was found that the opportunities perceived by the employees and their leaders with respect to digital maturity encouraged them to want to explore the benefits of digital maturity. This

finding is consistent with result of previous empirical research (Hell et al., 2016; Benbya et al. 2020; Selander et al. 2013). Though some other scholars (Karimi & Walter, 2015) in their studies refuted this relationship, which probably was because the relationship between perceived opportunity and digital maturity was mediated by the presence of perceived risk or other debilitating factors in the model.

The model also showed that there was significant positive association between digital organizational culture and digital maturity. This result implied that higher level of perception of digital organizational culture led to higher perceived digital maturity. This result was also corroborated by the findings of the qualitative phase of the research which was revealed through the thematic analysis and indicated that digital organizational culture played major role in digital maturity of the focal company. For instance, some of the interviewees disclosed that the digital organizational culture revolved around policies their leaders approve and that after all, it was the leaders who created the culture in the first place. Therefore, the digital organizational culture is not a company-wide practice which affects the level of digital maturity of the O&G industry.

While the effect of digital organizational culture on digital maturity has been consistently noted to be significant (Tallon et al. 2019; Fuchs and Hess 2018), poor digital organizational culture may be the bane of digital maturity in the O&G industry. Though digital maturity is a multidimensional variable comprising of the following components: marketing, technology, culture, people, leadership, operation, and strategy (Campusneanu et al., 2021; Salume et al. 2021), but poor leadership with regard to digitalization may be enough to render digital maturity of an organization low even despite the organization scoring relatively high on other components. The reason for this is that it is the leadership which is responsible for the culture, how people are managed, technology, and strategy of the organization. For instance, in the qualitative research phase, it was revealed that the leaders did not want to take the risk

of implementing a company-wide digitalization, which of course shows their attitude towards risk taking.

It was found that perceived risk alone demonstrated significant, but inverse relationships with digital organizational culture, digital maturity, and digital transformation. However, digital organizational culture was significantly and positively related to digital maturity and digital transformation in the model. This implies that the presence of high perceived risk led to decreased levels of digital organizational culture, digital maturity and digital transformation. This finding is well supported by the result obtained in the qualitative research phase which showed that perceived risk was the major negative factor that discouraged the implementation and adoption of digitalization in the O&G industry in Qatar. The perceived risk is not limited to the leaders alone, but also to the employees who are also threatened by the likelihood of losing their jobs due to digitalization. However, individually, the leaders and their staff desire that digitalization should be practiced company-wide. For instance, the leaders alluded to the desire to have their personal businesses digitalized, but such policy was frowned at if suggested to be implemented by their organization. The leaders cited cost as the main barrier to adoption of digitalization, while for the employees it was the anxiety it might cause over the security of their jobs. Though the leaders cited other reasons for not adopting complete digitalization such as security of data, not wanting to share their data publicly with other O&G companies in the industry, but the main reason was actually cost of implementing full digitalization.

This finding is congruous with results of prior studies (Muller et al. 2018; Flat et al. 2016) which reported that perceived risk was a major factor in the acceptance of a new technology as it can negatively impact adoption. Models such as the TAM, PBC, PMU and others have reported the negative impact that perceived risk on behavioral outcomes. However, such negative effect can be mediated by the presence of perceived opportunities which the

interviewees noted was critical to receiving the benefits of digitalization. In other words, perceived opportunity may reduce the negative impact that perceived risk has on the outcome variables.

It was revealed that there was a significant association between perceived opportunity and perceived risk. In the second model, it was demonstrated that perceived opportunity mediated the associations between perceived risk and digital organizational culture. The association between perceived opportunity and digital organizational culture was significant, which confirmed a partial mediation. From the second model, the second mediation model tested showed that digital organizational culture and perceived opportunity were significantly related. More so, organizational digital culture was revealed to mediate the association of perceived opportunity with digital maturity. The relationship between digital organizational culture and digital maturity was significant, which confirmed a partial mediation.

The relation of perceived opportunity and digital organizational culture with digital transformation was significantly mediated by digital maturity. Digital maturity had significant positive relationship with digital transformation. Moreover, a partial mediation occurred for perceived opportunity and digital organizational culture. Due to the poor fit, a new model was tested in which perceived opportunity and digital organizational culture as possible mediators of perceived risk leading to improvement in the model. Additionally, the role of digital organizational culture as possible mediator of perceived opportunity was also included in the new model.

These findings were in line with what was obtained in the qualitative research except for the relationship between perceived risk and perceived opportunity. In the qualitative phase of the study, perceived risk adversely affected perceived opportunity as it diminished the perception of the benefits digitalization can have in the entire organization. Of course, this was related to the cost of implementing digitalization in the entire organization rather than limiting

it to refinery operation as it is currently the practice in most of the big O&G multinational companies, including the O&G organization sampled in this study. Perceived opportunities (Argenti, 2016; Roy & Khastagir, 2016) and perceived risk (Muller et al. 2018; Flat et al. 2016) are human-related factors that have been reported in previous research to impact on successful digital transformation.

5.3 Implications of Findings

The result of the study based on the objective of the study revealed that digital transformation in the oil and gas industry in Qatar has both enablers and barriers. In particular it was found that perceived risk contributed mot negatively to digitalization in the O&G industry with the leaders abhorring anxiety for digital transformation due to the cost of implementation and maintenance as well as because they felt that it might expose the company's confidential data to those who may not be able to manage it. Particularly, perceived risk was found as the major factor or variable that negatively impact digital transformation and complete digitalization. This finding implies that risk is the major debilitating factor preventing full digitalization in the O&G industry in Qatar and by implication globally in the industry. This result has further implication for lowering anxiety over the cost of digitalization as the benefits outweigh the risks.

The anxiety based on the finding of this study was not limited only to the leadership of the sampled O&G firm, but was also found perhaps more noticeable among the staff. The staff felt that complete digitalization in form of digital transformation would lead to significant job loss, mostly especially among lower cadre staff. While this may be true, this perception of job insecurity has implication for more effective training and education for the lower level staff with respect to IT skill and job mobility, which is probably absent for now. For the leaders, associating digital transformation with high cost might probably have been informed more by

the state of the O&G industry globally due to lower cost of petroleum products, which probably has probably led to taking parsimonious approach to management in the industry. The implication of this finding is that there is need for sensitization through effective training for the leaders in the industry. Past studies () have shown that leaders should continuously be sensitized to the benefits they can realize through not just mere automation of their organizations' processes, but complete digitalization through digital transformation. Training on cost benefit analysis (CBA) with respect to digitalization may be implied in this instance.

The study showed that perceived opportunity had positive association with digital maturity. This result revealed that the more the perceived opportunity that is associated with digitalization the more the digital maturity. The leaders and the employees perceived that the implementation of digital transformation might lead to many opportunities for the O&G industry in Qatar. Both the leaders and their staff spoke glowingly about the possibilities that digital maturity could lead to improved operations in the downstream sector. The implication of this finding is that future researchers should investigate the specific opportunities perceived by the leaders and their staff in the O&G industry in Qatar and by extension globally. Some researchers () have argued that the perceived opportunity was in terms of operational efficiency that digital transformation in the O&G industry can elicit. However, is such efficiency only limited to refinery operations in the downstream sector? Digital maturity is considered critical to digitalization and the extent to which opportunities are perceived was related to digital maturity. However, the implication of this finding is that it is necessary for future researchers to determine the very aspect or dimensions of digital maturity that are directly impacted by perceived opportunity.

It was also found that there was negative linear relationship between perceived risk and digital organizational culture. This result is a confirmation of the negative impact of perceived risk on perception of digitalization. This result thus suggests that perceived risk is a strong

variable in digital `perception outcomes. This result implies that future researchers should investigate those aspects of digital organization culture that have strong inverse, but not linear relationship with perceived risk. This is important as studies have shown certain aspects or dimensions of digital organizational culture may be positively related to perceived risk. Moreover, digital organizational culture has mainly been studied as a dimension of digital maturity and therefore literature mainly fails to identify that digital organizational culture is a multidimensional variable and so should be investigated even while making it a dimension of digital maturity. In addition, the result also has some implications with respect to the digital organizational culture of the focal company. The digital organizational culture of the selected organization seemed to be evolving as it was not so strong that ensure the implementation of digital transformation. More so, the employees and their leaders agreed that if the company was their personal business, they would have implemented digital transformation as they viewed such change as not only desirable but also very essential in today's disruptive business environment. Thus, the finding implies that incapacitation of the leadership of the focal company stemmed from the weak digital organizational culture.

The study found that perceived risk, perceived opportunity, and digital organizational culture significantly predicted digital transformation. However, perceived opportunity was inversely associated with perception of digital transformation. The theoretical implication of this result is that digital transformation model needs to integrate perceived risk as the major barrier to successful digitalization. The current models of digital transformation integrate mainly pro-social behavioral factors such as perceived opportunity, culture, and organizational variables, but failed to consider factors that are likely to make digitalization unsuccessful. More so, the qualitative research finding also strongly pointed to the adversarial role of perceived risk in establishing successful digitalization in the O&G firm. This finding, with respect to its

implication, points mostly to the use of education and training as means to reduce the ill effects of perceived risk on digital transformation.

The model developed in this study explicitly showed that the variables: independent variables, mediator, and moderators are sufficient predictors of digital transformation in the O&G industry in Qatar. Therefore, perceived risk, perceived opportunity, digital organizational culture, and digital maturity are good predictors of perception of digital maturity. This is not to say that other factors not considered in this study do not have better relationship with the criterion variable. By implication, there is need for further investigation in order to establish the effects of other variables not included in the model.

CHAPTER 6: RECOMMENDATIONS

6.1 Introduction

This chapter makes recommendations to industry leaders in the O&G industry based on the study objectives and findings. The recommendations were also made to reflect the current thinking concerning digitalization globally and how it is being influenced by organizational factors, leadership, and employees' characteristics.

6.2 Recommendations

The finding of the study showed that perceived risk was inversely related to perceived risk, but the relationship between the two variables was significant. Further scrutiny of the result revealed that perceived risk was a significant predictor of digital maturity. Based on this finding, it is suggested that the oil and gas industry here in Qatar should pay salient attention to how employees and their managers view the implementation of digitalization as a policy. It is not being said here that the industry is not digitalized, but that the digitalization is only partial and limitation to certain processes as it is currently done in refinery operation. It is obvious that finance plays a major role in the leadership reluctance to implement full digitalization, but aside finance, perceived risk also plays important role in the decision not implement full digitalization. The implementation of digital transformation in the O&G industry comprises of three pillars: corporate culture, administration, digital strategy, and process improvement. Digital strategy has been the lowest with respect to digitalization. For instance, due to perceived risk as regard the cost and data security, there has been poor attention to digitalization, which has led to low digital maturity.

To improve digital maturity, it is necessary to engage leaders more with regard to the benefits the industrial can derive from high level of digital maturity. Since the significant drop in the process of crude oil in the market, the industry has been looking for ways to improve its

efficiency. One of the ways that efficiency in the industry can be improved is to implement full digitalization. This was part of the suggestions made by some of the interviewees as they viewed complete digitalization as direct means of improving the organization performance. Though they revealed that the organization has digitalized its processes, but not as much as they should have. This is probably because digitalization as it were is only thoroughly being implemented in the refinery operations. To improve digital maturity, it is important to reduce or eliminate anxiety among the staff and their leaders. The cost the organization would incur in the course of implementing full digitalization would be made up for by the improved efficiency and performance that would ensue. Improved digital maturity can lead to better performance for the employees, processes, and supportive culture.

Perceived opportunity and organizational digital culture significantly predicted digital transformation. However, perceived risk independent prediction of perceived digital transformation did not receive statistical support. Perceived opportunity is an important variable in the model as it significantly predicted perception of digital transformation, while perceived risk did not. The reason for this result has been explained sufficiently explained in the preceding chapter. Though there may be need to give a little background to what occurred. The presence of perceived opportunity and organizational digital culture in the model actually suppressed the effect of perceived risk. Thus, to improve the possibility of digital transformation both perceived opportunity and digital organizational culture may play significant roles. For instance, in the O&G pillars, digital strategy and culture were identified as critical to the performance of the industry. Though the role of perceived opportunity was not mentioned, but this also creates challenge for the industry. For instance, top of the mind during the interview were changing the mind set of all stakeholders and changing the working method of the entire organization with regard to digitalization which are of course related to culture

and digital maturity pillar. The most challenging of the pillars are culture and digital strategy and it is because they are driven chiefly by human perception.

More so, since perceived constitute the biggest challenge in this study for implementing successful digital transformation, it is only normal to enhance perceived opportunity so as to suppress the ill effect of perceived risk on perception of digital transformation. Through enhancing perceived opportunities in the implementation of digital transformation this can lead to better perception of digital transformation in the O&G industry in Qatar and globally. Perceived opportunities in digital transformation can be created by management when they tie digital training to incentives such that leaders and employees who improve themselves digitally through in-house training and personal development can be elevated or given some kind of incentives whether tangible or intangible.

Literature has also tied the poor digital transformation in the O&G industry globally to weak experience among leaders. This may also play some part in perceived risk as weak experience can result to high level of anxiety, which in turn may lead to poor receptivity to perception of digital transformation. To alleviate this condition learning opportunity should be available for leaders and their staff. Learning opportunity should focus on current digital skills such as the use of Industry 4.0 such as Internet of Things (IoT) and other areas of Industry 4.0. This researcher recognizes though the cost implications of implementing digital transformation, but the benefits far outweigh the costs and therefore the human challenges should be tackled to allow its implementation.

The result of the study revealed that digital organizational culture was a significant independent predictor of digital transformation. Digital organizational culture can be considered as being part of the core component of organizational culture in today corporate digital world. Moreover, digital organizational culture is indirectly one of the main pillars of O&G industry as it relates to the pillar of core value. This shows that organizational digital

culture is crucial for managing digitalization and efficiency in the industry. More so, digital organizational culture is one of the core values of the industry and therefore it can be used to change the perception that the leaders and their employees have towards digital transformation. If the culture is supportive, friendly, cooperative, and learning, it is likely it may also support digital transformation.

Digital transformation will require learning and of course it is appropriate to expect such culture to embrace or open to learning new things. The leaders should therefore promote digital organizational culture by making the industry be more friendly, supportive, cooperative, and leaning. This also implies that training should be at the heart of the organizational culture that the organization should foster or promote among its workforce. The finding revealed that digital maturity mediated the relationship between perceived risk and digital transformation. The mediatory role of digital maturity in perceived risk and digital organizational culture was also supported. Perceived opportunity mediated the relationship between perceived risk and organizational transformation. These results showed that the entire variables investigated in this study were significantly related and that the presence of any of the variables either suppressed or elevated the dependent variable. Therefore, intervention towards improving the perception of digital transformation should focus on these factors. In fact, the results indicated that well perceived opportunities in digital transformation, low level of perceived risk, strong digital organizational culture, and digital maturity positively influence perception of digital transformation.

Management in the O&G industry should pay salient attention to these factors as they have the ability to improve how leaders and employees in the industry view digital transformation. For instance, digital maturity is critical to attainment of digital outcomes and therefore improving digital maturity will not only lead to better digital organizational culture,

but may also affect perceived opportunity due to positive perception of digitalization. To this end, management in the O&G industry should lay more emphasis on improving digital maturity so as to improve the perception of digital transformation among key stakeholders. This is important as key stakeholders themselves in the industry seem to have not too positive perception of digital transformation. How else can one explain a situation where the refinery operation is digitalized, but other departments in the organizations are not? If they were using refinery operation as a form of simulation or test to determine if digital transformation will be successful, for how long shall this simulation take place before setting up a full digital transformation implementation?

Therefore, the key factor in introducing fully blown digital transformation is to change the perception of the key stakeholders. This should start with effective training to leaders (e.g., directors) and managers. Managers should play significant roles by being involved in every aspect of project management with the use of 4.0 Industry. Constant exposure to such factors as Industrial Internet of Things, big data analytic, algorithm, cloud computing, augmented reality, cyber security, advanced robotics, simulation, additive manufacturing, and vertical and horizontal integration system will benefit the system by changing how digital transformation is perceived.

CHAPTER 7: CONCLUSION

7.1 Introduction

In this chapter, the researcher made conclusions regarding the findings of the study with focus on the objectives the researcher identified at the beginning of the study.

7.2 Conclusion

It was found in the study that perceived risk was negatively associated with digital maturity. Thus, the higher the perceived risk, the lower the level of digital maturity in the O&G industry in the State of Qatar. Perceived risk was shown to be a strong factor which adversely contributed to digital transformation in the O&G industry. Managing perceived risk has strong implication for digital outcomes such as digital maturity as high perceived risk does not only discourage aiming for high level of digital maturity, but is also likely to impact on other important digital outcomes. Perceived risk was high due to the fact that leaders in the selected organization abhor negative perception regarding high level of digital maturity. Working towards attaining strong digital maturity seems not be the case in the industry. Thus, high perceived risk led to lower level of digital maturity.

The finding of the study showed that perceived opportunity and digital organizational culture predicted digital transformation. However, perceived risk did not predict digital transformation, while perceived opportunity and digital organizational culture predicted digital transformation in positive direction. The logical conclusion from this finding is that digital transformation is a function of perceived opportunity and digital organizational culture. What this translates to, is that perception of digital transformation in the O&G industry is mainly influenced by factors within the organization more especially the perception of leaders who are key stakeholders. However, perceived risk due to the presence of both perceived opportunity and digital organizational culture strength of prediction of the criterion variable was weak.

Conclusively, it can be said that the positive contributions of perceived opportunity and digital organizational culture weakened the role played by perceived risk in digital transformation.

Digital maturity and digital organizational culture were moderators in the model and were tested against each of the exogenous variables with the result indicating that perceived risk did not significantly predict either digital maturity or digital organizational culture. However, perceived opportunity predicted both digital maturity and digital organizational culture in positive direction. However, in the model, the exogenous variables predicted perception of digital transformation. The first conclusion that can possibly be drawn from this finding is that perceived opportunity is central to digital maturity and organizational culture, while the second conclusion is that perceived opportunity, perceived risk, and digital maturity are strong sign post for digital transformation implementation.

7.3 Limitations and Suggestions for Further Studies

The findings of this study are by no mean exhaustive. Therefore, certain factors have limited the generalizability of the results. Chief amongst these factors was that only one organization from the O&G industry in the State of Qatar was selected for the study. It therefore indicates that the results of the study must be interpreted with utmost caution as the data collected was not a representation of the entire O&G industry with respect to the phenomena investigated. In view of this limitation, future researchers who want to replicate the findings of this research should select more organizations in the O&G industry in Qatar in order to increase the findings generalizability to Qatar and by extension to the O&G industry globally.

Another factor which has affected the generlizability of the findings of this study was the research design, which was cross-sectional in nature. Cross-sectional data has been criticized for certain weaknesses such as lacking in external validity, being appropriate only for exploratory research, poor replicability etc. However, its use in this study was practically explorative and was complemented by the use of qualitative data in order to improve the

findings external validity. Despite this, future researchers may adopt more robust research design such as quasi-experimental design so as to improve the findings external validity.

It is also necessary to point out that the data collected for this study only represented the refinery operation of the selected O&G organization and not the entire organization. This limitation implies that the result may be generable to the entire organization. Researchers who have interest in replicating the findings of this study may need to carry out the research in the entire organization in order to understand the prevalence of perception of digital transformation in the selected organization.

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Appendix: 1

Survey Questionnaire

Dear Research Participant,

This study with the following title: The Impactof Force Factors on The Perceived Benefitsof Digital Transformation in The Oil& Gas Industryin The Stateof Qatar, is in partial fulfilment of the award of MSc in Engineering Management from Qatar University. You have therefore been chosen as one the participants of the study. In view of this, you are expected to respond to some survey questions which will not take more than 5 minutes of your time as responses will be taken online. You do not need to spend too much time on any questions as this exercise is not a test of your ability at work and there are no right or wrong answers. Your participation in this study is totally voluntary and you can choose to exit the research at any time. You are guaranteed absolute anonymity as your identity will remain undisclosed throughout the study. In addition, the information you give to the researcher will be held in strict confidence.

Thank you.

Sincerely yours,

Ali Alkubaisi.

Section A: Personal Socio-Demographic Information

In this section, you are expected to click on the appropriate choices based on your personal information.

Gender: Male ( ) Female ( )

Chronological age: 18-20 ( ) 21-23 ( ) 24-26 ( ) 27-29 ( ) 30-33 ( ) 34-36 ( ) 37-39 ( ) 40-43 ( ) 44+ ( )

Department: Production ( ) Maintenance ( ) Business Support, Asset Integrity ( ) Safety ( )

Job position: Employee ( ) Frontline ( ) Middle Management ( ) Top Management ( )

Work experience: 1-2 ( )3-4 ( ) 5-6 ( ) 7-8 ( ) 9-10 ( ) 11-12 ( ) 13-14 ( ) 15-16 ( ) 17-18 ( ) 19-20 ( )

Highest Education Level: Primary School ( ) Secondary School ( ) Vocational School ( ) University ( )

Section B: Perceived Risk

Please, indicate the extent to which the following statements describe your perception in respect to risk of digitalization in the oil and gas industry in Qatar. SA=Strongly Agree A=Agree NA=Neither Agree nor Disagree D=Disagree SD=Strongly Disagree

S/N	Statements	SA	A	NA	D	SD
1	Digitalization may not worth its costs					
2	Digitalization may frustrate my efforts at work because of the skills that I lack					
3	Compared with other policies, digitalization has more uncertainties					

4	I'm not certain if digitalization would be as effective as I think					

Section C: Perceived Opportunity

Please, based on the opportunities associated with digitalization, `kindly click on the following statements based on your perception.

SA=Strongly Agree A=Agree NA=Neither Agree nor Disagree D=Disagree SD=Strongly Disagree

S/N	Statements	SA	A	NA	D	SD
1	I would find digitalization useful in my job.					
2	Using digitalized system would enable me to aachieve tasks more quickly					
3	The opportunities in digitalized system will increase my productivity.					
4	If I use the new digitalized system, I will increase my chances of getting a better performance review rating.					

Section D: Organizational Digital Culture

Please, indicate how the culture in your organization has impacted on digitalization by clicking on the following statements.

SA=Strongly Agree A=Agree NA=Neither Agree nor Disagree D=Disagree SD=Strongly Disagree

S/N	Statements	SA	A	NA	D	SD

1	Decisions made within our organization are transparent to the staff					
2	Digitalization would influence decision-making agility of our firm					
3	In our business activities, employees, and executives exchange information about the digital transformation of our firm					
4	Continuous change is part of our corporate culture.					

Section E: Digital Maturity

Please, indicate how mature you think your organization is with respect to digitalization by clicking on the following statements.

SA=Strongly Agree A=Agree NA=Neither Agree nor Disagree D=Disagree SD=Strongly Disagree

S/N	Statements	SA	A	NA	D	SD
1	This organization implements a digital strategy.					
2	This organization's digital strategy is documented and communicated.					
3	In this company, company's digital strategy has a significant influence on its business model and operations.					
4	The digital strategy is continuously under evaluation and adaptation.					

5	Our executives support the implementation of the digital strategy					
6	Digital strategy is only implemented in isolated functional areas.					
7	The leadership culture in our company is based on transparency, cooperation, and decentralization of the decision-making processes.					
8	Our company's digital strategy has an influence on the tasks and profiles of executives.					
9	Digital products and services are integrated into our interfaces and business processes and create a noticeable impact on the customer experience.					
10	In our company, there is a direct creation of added value through the progressive digitalization of products and services (e.g., cost reduction, increased productivity, improved customer experience, customer differentiation).					
11	Digital products and services have a broad impact on our company's overall performance					
12	Our company is creating a significant sales volume through digital channels.					
13	There are sufficient resources (time, people, budget) available to implement the digital strategy within our company.					

14	We establish a strong multidisciplinary cooperation and co-creation between stakeholders across our value chain.					
15	Physical and digital processes are fully integrated through holistic process models					
16	The strength of our digital strategy is driven by innovations in operations.					
17	Within our company, there are specialists in core issues related to digital transformation.					
18	Within our company, comprehensive measures to strengthen digital literacy are implemented.					
19	Within our company, new job profiles have been created for employees with expertise in core topics of digital transformation					

Section E: Digital Transformation

Please, indicate the extent of digital transformation in your organization by `clicking on the following statements.

SA=Strongly Agree A=Agree NA=Neither Agree nor Disagree D=Disagree SD=Strongly Disagree

S/N	Statements	SA	A	NA	D	SD
1	Information and communication technologies like analytics as well as social media are used to understand our customer in a better way.					

2	Digital channel like online, social media are used to understand market movement aswell as marketing of products					
3	Organization uses digital channels to sell their products &services					
4	Digital channels are extensively used to extend better customer service					
5	Digital technology is extensively used for having customer interface with operational processes					
6	All our core processes are digitally automated					
7	Extensive digital technologies are applied in our organization for integration of customer information with production and operation					
8	My organization use analytics for taking better operational decisions					
9	For improving performance and value of our product, company use digital technologies extensively.					
10	We focus on digital technologies for launching new business models					

Interviews Questions

Digital Transformation

1. What does digital transformation really mean for today's business leaders?

2. What does digital transformation mean for the oil and gas industry in Qatar?

3. What does digital transformation mean for the oil and gas industry globally?

4. Where should businesses in the oil and gas industry in Qatar start with digital transformation?

5. What are the barriers that usually block the path to transformation?

(What is the culture needed for digital transformation?

6. What is a digital business platform?

7. Why would an organization need a digital business platform?

8. Why would someone choose onedigital platform over other platforms?

9. How does management of your company feel about digital transformation? Probe

Digital Maturity

10. Do you understand what digital maturity is? Probe

11. To what extent can you say your company is digitally matured? Probe

12a. With regard to culture

12b. With regard to leadership

12c. With regard to the organisation

12d. With regard to technology

12e. With regard to Insight

Digital Organizational Culture

12. What do you understand by digital culture?

How adaptable or flexible is your organizational culture in terms of digitalization?

13. What do you understand by organizational culture?

15. Are there policies in your organizational culture that make digitalization important?

16. Would you say digitalization is part of your organization's value? How?

17. What are the human factors that make digital transformation possible in your company?

18. What are the human factors that can discourage your company from digital transformation?

19. Has your company tried to manage those factors that discourage digital transformation?

20. How did you company handle this?