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Critical Areas of Knowledge Loss When Employees Depart in the Oil and Gas Sector

Abstract

Purpose – The purpose of this article is to investigate the critical types of knowledge lost when employees depart in the oil and gas companies.

Design/methodology/approach –The study adopts a grounded theory methodology. 12 semi structured interviews were conducted from elite informants in oil and gas sector to gain an in-depth insight of the research problem. ATLAS.ti was used for data analysis and coding.

Findings – In oil and gas, the employees keep on rotating and work at various geographical locations during their career. The departing employees might possess various types of knowledge depending on the role and duties they have performed over the years. These include specialized technical knowledge, contextual knowledge of working at different geographical locations, knowledge of train wrecks and history of company, knowledge of relationships and networks, knowledge of business processes and knowledge of management.

Research limitations/implications –The study findings might only be applicable to oil and gas sector.

Originality/value – This paper fulfills an identified gap on identification of critical areas of knowledge loss when employees depart in oil and gas companies. The study makes an attempt to add to the existing body of literature on this underexplored area in knowledge management literature.

Keywords: Critical areas, Knowledge loss, Departing employees, Oil and Gas

1. Introduction

Knowledge in today's economy is the most valuable, competitive, and strategic asset which plays a vital role in fostering innovation and improving efficiency, productivity, and competitiveness of organizations (Grant, 1996). Organizations can lose their competitive advantage through the loss of knowledge workers. Jennex (2014) stated that NASA was unable to return to moon because they had lost knowledge of how to build rockets and spacecrafts through the loss of knowledge workers through retirements and deaths. Majority of the researchers have identified old age retiring workers as a key contributor to knowledge loss (Calo, 2008, Stevens, 2010, Ball and Gotsill, 2011), but knowledge loss also occurs due to turnover, job rotation and layoffs (Leibowitz, 2009). The current economic situation and changing workforce demographics have pressured companies to take some action and since, the baby boomer generation is the largest generation to enter the workforce, companies are endeavoring to retain their knowledge (Stevens, 2010). Organizations need to assess how this demographic trend will affect their individual companies, analyzing its potential impact on each business unit, location, and job function (Strack et al., 2008). There is a huge challenge in terms of aging workforce as large number of employees near retirement will leave the industry soon, thus begetting a profound knowledge loss. Layoffs also occur when the businesses are not performing well for example in oil and gas sector at the moment because of low oil prices. In such scenarios, the knowledge loss is accelerated through the departure of employees (Durst and Aggestam, 2017). Thus, it is important to identify the critical knowledge possessed by departing employees and responding appropriately to retain that knowledge. An important step in the knowledge retention process is to determine the critical "at risk" knowledge (Leibowitz, 2009). When critical knowledge workers leave the organization, there is a risk of knowledge loss which could be basis for competitive advantage for organization (Spender, 1996). These workers can take with them "a substantial volume of tacit knowledge, operational heuristics, stores and organizational history" (Jackson, 2010, P.908). Ebrahimi et al. (2008) emphasized the importance of these workers as "Their life experience, their in-depth knowledge of different professional environments (network of contacts, who knows what?), and their knowledge of the culture of these environments (collection of codes, symbols, shared significance, etc., permitting to know how to deal with who?) bestows them differentiated aptitudes to understand issues, interpret information, connect various information and data, integrate knowledge, and finally, connect and

coordinate knowledge carriers" (p. 129). Thus, the retention of such critical knowledge is of utmost importance in view of an organization's continuity (Durst and Aggestam, 2017). The literature reveals that organizations don't have systematic procedures to assess the knowledge of departing employees (Jennex, 2014). Although firms are constantly investing in activities related to knowledge creation and technological capabilities however, retention of critical knowledge is a neglected task. Further, there is lack of empirical research on identification of different knowledge types possessed by departing employees (Joe et al., 2013). If managers know what to retain from the leaving employee, organizations can perform retention of knowledge in more effective way. Previous studies have discussed the impact of knowledge loss (Levy, 2011, Massingham, 2008, Bleich et al., 2009, Cattani et al., 2013, Calo, 2008, Dumay and Rooney, 2011), knowledge retention strategies (Gotthart and Haghi, 2009, Parise et al., 2006, Bratianu and Leon, 2015, Daghfous et al., 2013, Durst and Aggestam, 2017), intergenerational learning (Ropes, 2015, Kuyken et al., 2009, Ropes, 2013, Harvey, 2012, Baily, 2009, Bratianu and Leon, 2015), however, there is paucity of research on what to retain from the experts especially the individual knowledge types of the departing employees (Joe et al., 2013). An employee who has been working for 20 or 30 years in an organization in different positions and at various locations in case of MNCs such as oil and gas, he might have a varied skill set and expertise in different areas. In order to retain his vast amount of knowledge on know-how, know-what and know-who, it is required to know the different types of knowledge and skills he has acquired over the years. Thus, this qualitative study aims to address this research gap by addressing the following research question.

RQ1: What are the critical types of knowledge lost when employees depart from the oil and gas industry?

Interviews have been conducted from key informants in oil and gas sector to explore the various types of knowledge that need to be retained when employees leave. Six knowledge types have been identified. The target sector is oil and gas as it is facing a work force crisis because of aging workforce issue and low oil prices (Sumbal et al., 2017). As such, this article makes important contribution in highlighting the value of knowledge retention especially in the context of oil and gas sector and identification of the different types of knowledge to be retained from the departing

employees in oil and gas companies. Further, it advances our understanding towards the knowledge retention process and knowledge areas of significance importance. Rest of the article is structured as follows. Section 2 will cover the literature review. This is followed by section 3 elaborating the methodology adopted for the study. Section 4 represents the results and analysis and section 5 concludes the study along with addressing the implications and future research directions.

2. Literature Review

2.1 Knowledge Loss in Oil and Gas

Nowadays, firms especially multinational corporations rely on various sources in order to combine the internal and external knowledge (Ferraris et al., 2017). These sources include customers, competitors, suppliers, databases, cops etc. Among these MNCs, oil and gas sector holds a pivotal role and most of the industries are functioning because of oil and gas. The oil and gas industry is considered to be the pioneer in the field of KM and energy giants in this sector were considered as examples in term of KM initiatives and were followed by many organizations. However, studies (McKenna et al., 2006, Grant, 2013, Shuen et al., 2014, Inkpen and Moffett, 2011, Sumbal et al., 2017, Sampath and Robinson, 2005, Gould et al., 2007) indicate that the phenomenon of baby booming and aging workforce hasn't been handled well in this sector and this sector has considerably high percentage of aging workers. Although the aging workforce issue is a challenge to every company, it has affected oil and gas sector in particular. The oil and gas survey conducted by Microsoft in 2011 revealed that 40% of the people were older than 50 and about 60% were older than 40. So, by now, these guys will be near retirement. In addition to that, the oil and gas sector is not considered as desired career path by most of the younger generation and less people are coming to this sector (Inkpen and Moffett, 2011). Thus, this makes the situation more challenging for the oil and gas sector. The recent study by Sumbal et al (2017) indicates that oil and gas organizations consider this aging workforce as a serious threat and not many initiatives are being taken to retain the knowledge of these retirees. Oil and gas companies have offices at multiple locations and multi-million-dollar projects going on in

various parts of the world. In order to remain competitive, these companies need to invest in right places and at right time. Such decisions require expert insights from the people who have a lot of experience in such projects and most of these employees are senior workers who will be retiring soon. The knowledge of these employees is thus very crucial for the organizations and proactive efforts are required to retain this as Sumbal et al (2017) state that "These people are knowledge banks that have deep experience in managing situations. You have many good young engineers but with old workers, when you have 20-30 years of experience, you look at the problem from different angles and thus you can make a better decision" (p.914).

2.2 Knowledge lost when employees depart

In today's economy, the key to success is that firms must leverage their abilities to use existing knowledge for the creation of new knowledge (Gold et al., 2001). The most important rule is that knowledge needs to be managed and thus requires vision and strategy (Ulrich, 1998). Organizations most of the time ignore the importance of intellectual capital and fail to capitalize on its benefits (Giacosa et al., 2017). Jennex (2014) defines the risk of knowledge loss as the possible impact on the organization regarding efficiency and productivity due to loss of an expert or knowledge worker. Massingham (2008) builds on this IC theory and states that when employee leaves, organization loses human capital knowledge, structural capital knowledge, relational capital knowledge and social capital knowledge. Lost human capital decreases organizational output and productivity, lost social capital reduces organizational memory; lost structural capital diminished organizational learning and lost relational capital may produce disrupted external knowledge flows. Thus, due to departure of critical employees, organizations are faced with loss of business opportunities and decrease in the revenue of organization (Leibowitz, 2009, Daghfous et al., 2013) and along with that lower productivity and workflow disruptions (Burmeister and Rooney, 2015, Caroline Martins and Meyer, 2012). Loss of a valuable employee can result in both financial and non-financial loss, and in the process of succession planning, an organization should not only focus on finding a suitable successor but also should focus on the retention and transfer of the critical knowledge of the departing employee (Durst and Aggestam, 2017). Parise et al. (2006) found that organizations only capture small portion of the individual's knowledge and do not focus on the complete skill set of the employees which made them successful and knowledgeable (Jennex, 2014). Organizations that

are able to retain critical knowledge have higher capability of acquiring and assimilating new knowledge.

Employees leave the organization for various reasons such as retirement (Collinson, 2014), job change, disability, (Caroline Martins and Meyer, 2012), turn over etc (Wang et al., 2017). Over the years, employees gain experience and knowledge while working in specific industry, and a key point for the organizations to think is how to capture, share and apply the knowledge of these departing individual in best possible way in order to foster knowledge creation and innovation (Leibowitz, 2009). It can be very challenging for organizations to successfully identify and retain valuable industry and company knowledge (Durst and Wilhelm, 2013, Massingham, 2008, Bender and Fish, 2000, Cattani et al., 2013, Giacosa et al., 2017). Organizations, in most cases, don't even know what to capture from these leaving employees (Sumbal et al, 2017). Managers should be tasked with the responsibility of identifying the at-risk positions, and then of developing a plan to identify a successor (Jennex, 2014), of having an accelerated learning plan for the identified successor, and of facilitating the transfer of knowledge from the incumbent workers to successors (Calo, 2008). It is required to properly analyze the skills and capabilities of these employees as they might be working on different job assignments during their career and have variety of expertise in different areas within the organization (Sumbal et al, 2017). Levy (2011) emphasized the knowledge retention and based on a multi case study of seven organization, proposed that a knowledge retention process should consist of three steps, i) Identification of critical knowledge, ii) Transferring of critical and undocumented knowledge and, iii) integration of retained knowledge for reuse in organization's business processes. This point one; identification of critical knowledge is the unique types of knowledge and skills possessed by the employees whether it is knowledge related to management, technical areas or relationships (Joe et al., 2013). Alavi and Leidner (2001) describe a knowledge taxonomy providing a possible context for considering the different knowledge types that the departing employees might possess (Joe et al., 2013). These are i) declarative or explicit knowledge (know about), ii) Procedural or tacit knowledge (know how), iii) causal knowledge (know why), iv) conditional knowledge (know when) and v) relational knowledge (know with). Thus, this taxonomy provides a broader context of knowledge types that could be useful for the organizations but there is a need for further refinement and elaboration. Further, Eucker (2007) states that by losing an experienced employee, organization loses knowledge of know-how,

know-what and know-who. Durst and Wilhelm (2013) also talk in general terms of lost structural capital, human capital, relational capital and social capital when employees depart. Daghfous et al (2013) describe the knowledge loss in terms of component and architectural knowledge where component knowledge comprises of sub-routines or discrete aspects of a firm's operations, whereas architectural knowledge encompasses firm-wide procedures for integrating the different components of the firm to run the operations smoothly. Similarly, Jennex (2014) talks about the competency profile on the unique skills of the employees when assessing their knowledge. This competency profile checks if a skill possessed by employee is in demand by the organization or if an employee is a key contributor for products/services offered by organization and last but not the least, if he has knowledge of organizational events and projects etc. Bratianu and Leon (2015) also elaborate on knowledge loss and categorize organizational knowledge as cognitive, emotional and spiritual knowledge. Cognitive knowledge is rational knowledge residing in words and behaviors, emotional knowledge is unconscious knowledge generated by sensory systems and transformed into feelings and finally spiritual knowledge relates to the professional and cultural values that guide our behavior and decisions. Thus, these studies provide a broader and general description of knowledge types and mention about unique skills and competencies of the departing employees but there is lack of description of these unique skills and these studies do not dwell into the identification of individual knowledge types of the departing employees especially in terms of breaking down the skills of the employees according to work performed over the years. Joe et al. (2013) also support this and state that majority of the literature talks about the knowledge loss issue due to departing employees but what to look for when these employees leave is underexplored. The current study tries to bridge this gap by using a grounded theory methodology and focuses on determining the critical areas of knowledge for the organization which will help in carrying out knowledge loss assessment in a more appropriate way by targeting those areas. No previous studies on identification of critical areas of knowledge and what type of knowledge to retain from the departing employees apart from one study by Joe et al. (2013) which focuses on SMEs and tried to investigate the knowledge lost when old experts leave the organizations.

2.3 Research Context and Motivation

The current study focuses on oil and gas sector. The oil and gas industry is unique as it is spread across different geographical locations and people work in extremely different environments for

example companies have installations under the sea, in mountains, in snowy areas and thus the type of experiences and knowledge they possess might be quite different specially for retirees who spent around 20-30 years working in oil and gas. Further, oil and gas companies have larger setups and different sectors such as upstream, mid-stream and downstream, each performing a different function thus the types of knowledge possessed by employees in oil and gas sector were bit different as compared to those in SMEs as will be discussed in results section. Thus, this study aimed to produce some fresh knowledge on the subject by conducting a research in the oil and gas sector. Moreover, this retiring phenomenon is very critical in oil and gas (Ball and Gotsill, 2011, McKenna et al., 2006, Gould et al., 2007) and also because of the cyclic nature of the industry and fluctuating oil prices, there are no stable jobs causing an issue of retaining workers (Inkpen and Moffett, 2011, Sumbal et al., 2017). These factors make oil and gas sector an important industry for the research regarding knowledge loss due to exiting employees. Thus, an in-depth study with rich insights from the organizations can explore the different types of knowledge possessed by employees.

3. Methodology

Research method is normally selected for its appropriateness in exploring a specific research topic. The qualitative approach has been adopted for this study. Naturalistic concepts can characterize qualitative approach such as closeness (Patton, 1987), and "a set of interpretive, material practices that make the world visible" (Lincoln and Denzin, 2000:3). Qualitative research method is effective when the topic is underexplored and has obtained a little academic attention as is the case for the current study. The qualitative study aims at exploring a topic and giving an opportunity to the participants to respond in their own words and thus tends to be very rich and explanatory in nature (Punch, 2013).

Grounded theory method has been adopted in this study due to its capacity of exploring a research topic in depth. Glaser and Strauss developed grounded theory method in the 1960s during a period when qualitative approaches were considered nonscientific. Grounded theory has since achieved wide acceptance and popularity because of its systematic way of inquiry and rigor. In addition to advantage of investigating under explored areas, grounded theory is particularly useful for generating theoretical perspective to explain the phenomena under study thus contributing towards fresh knowledge in this area of study through the lens of participants

involved in the study; thus the term grounded theory arises as the outcomes are grounded in data by following a systematic procedure (Charmaz, 2006). Interviews have been conducted for data collection. Data collection through interviewing is quite flexible and it allows the researcher to communicate with participants easily. Rubin and Rubin (2011) state that qualitative interviewing helps obtain rich data to build theories that describe a setting or explain a phenomenon in a sequence, with the help of examples and experiences collected during the interviews. Thus, interviews provide flexibility in some ways and moreover, provide an opportunity for interactive dialogue with the respondents for a detailed exploration of the topic. For this study, 12 semi structured interviews were conducted from oil and gas experts to explore the area of knowledge loss. The participants were contacted through LinkedIn profiles and through contact points of the research team. The criteria for the selection of the participants included the experience, position and company size. Moreover, as the aging workforce issue is more common in Western countries especially, USA, Australia and Europe, more companies were included from these regions. Thus, the participants represented oil and gas companies from these geographical locations and were key or elite informants with extensive amount of experience in oil and gas industry. Moreover, most of them were directly involved in knowledge managing activities within their respective organizations as is evident from table 1 showing the details of these participants in the study. Seven out of twelve participants were either KM managers or coordinators in their respective organizations. Through the consent of participants, the interviews were recorded and transcribed afterwards. Few of the participants preferred replying through emails and thus questions were sent to them. Participants were contacted back several times to clarify answers in case of any ambiguities and if any further insights were required. Using the qualitative analysis software, ATLAS.ti, each interview was analyzed line any line and codes were generated highlighting the main concepts and themes. Through constant comparison method, the data from each subsequent interview was compared to find out the similarities and differences in the data. Further refinement of data helped in identifying the codes which were pertinent to current research and provided the answers to the research question. The flexible data collection strategy with open ended and probing questions was in line with the grounded theory approach of qualitative analysis. This approach helped in generating codes and categories that were grounded in data and made it possible to look for emerging themes and constructs beyond the ones identified in prior literature (Daghfous et al., 2013).

Interviewee	Years of Experience	Position	Company	Location
1	10	Managerial/ KM Consultant	A	USA
2	7	Managerial/KM Coordinator	B	Australia
3	35	Director/ KM Lead	C	Netherlands
4	20	KM Manager	D	UK
5	32	Managerial	E	UK
6	7	Managerial/ KM Coordinator	F	Italy
7	16	Managerial/KM Lead	G	Thailand
8	9	Managerial	H	Norway
9	10	Managerial	I	UK
10	8	Managerial/ KM officer	J	Russia
11	10	Managerial	K	UAE
12	13	Managerial	L	Australia

Table 1: Details of Participants in the Study

The data collection stopped when saturation point was reached and additional data was not providing any new insights in relation to the inquired research questions (Pandit, 1996). The generated codes from data, then eventually became the categories of higher abstraction to identify the types of knowledge lost when employees depart, as described in the results section. During the coding process, memos were also written simultaneously which explained the relationships among the codes generated from the interview data (Charmaz, 2006). These memos served as foundation for performing analysis of coded data and further, these memos also guided towards subsequent data collection on emerging themes and concepts. The output generated

through this coding process in ATLAS.ti is mentioned in appendix in the form of a network view. The results of the study are supported through a dialogue with the existing literature for similarities and contrast. In addition, member checks were also performed for validation of results.

4. Results

It is typical to identify the critical knowledge types possessed by departing employees as then, the managers can assess what knowledge is to be captured and retained for the organization. So, it was inquired from the participants about the different knowledge types that the departing employees possess. A range of knowledge types were discovered and will be discussed further.

4.2.1 Specialized Technical Knowledge

The technical knowledge was the most important one as agreed by all participants. Thus, if a departing employee possesses specialized technical knowledge, his knowledge should be captured and retained. This knowledge can be divided into different domains in oil and gas. Each discipline has a different suite of technical knowledge and skills associated with it. According to interviewee 1, the technical knowledge skills really depend on the areas and functions within the oil and gas sector as he stated that:

"*When it comes to drilling, ability to understand the environment and run the team correctly, to have the experience of when things go wrong, how to handle something that is stuck down the hole, from an engineering point of view, it is the ability to track large projects. And be able to make sure everything is on point*"

Participants agreed that critical knowledge areas where companies don't want to lose knowledge are the areas that can bring competitive advantage i.e. how to interpret seismic data, how to bring

up hydrocarbon for production etc. Seismic surveys are used to understand the sub-surface structures to look for hydrocarbons. The knowledge about drilling involves understanding the rock structures, where the actual well is to be drilled. For efficient production of hydrocarbons, a properly drilled well is of critical importance. Interviewee 12 was of the view that most important thing is the technical understanding of a sedimentary basin from which potential commercial success flows. The importance of this technical knowledge was further highlighted, by interviewee 8 who was from upstream sector, stating that:

"*So, if we talk about specialized technical knowledge, then, how you define reserves and report standards, how you meter error when measuring producing volumes, how you apply new technology to enhance well productivity and well drainage. Then, challenges when you change the ownership of assets. Changes in business models when used by operators, how you verify field and well data for public domain. You know, you have to report your reserves to the state and so on. This reporting data very important, once you report that to state, you need to stick on that. When you talk about these items, for example uncertainty in volume and place, as I said definition of reserves is very important, this is what includes specialized technical knowledge*"

Further the technical knowledge can involve, replacement of components in the refinery, specialized research & development knowledge, maintenance etc. Employees can use this knowledge to keep the equipment running for example ageing plants and to avoid mistakes made earlier by bad decisions. Similarly, when reservoirs deplete, the knowledge required for major component overhauls such as gas compressors is also of critical importance. Further, the responses revealed that technical domain covers research & development, chemical processing expertise, handling of field and well data etc. Thus, there was a high degree of consensus among the participants that subject matter experts have critical tacit technical skills which play a crucial

rule in running the expensive oil and gas projects, maintenance of all the plants and equipment as well as bringing innovation through research and development.

4.2.2 Contextual Knowledge: Knowledge of working at different places

As the employees in oil and gas companies move a lot across different geographical locations, they gain understanding and knowledge of working in different environments under different contexts. This knowledge of locations and environments was considered critical by all the interviewees. This involves knowing the surface characteristics of different geographical locations, understanding the environmental regulations, and political situations etc. for example interviewee 1 signified the value of this knowledge as:

‘‘*It is easier to drill in West Texas than in Angola for many reasons obviously. For example, if you are drilling in Angola, you need to bring someone; you need to bring people who have experience with the security, location things like that to protect your office. It is whole different dynamics; the logistics are harder to get into the country. So, all those factors count. If you would put someone from West Texas in Angola, they would not have knowledge to understand the political sensitivities, and the security measures need to ensure safe operations.”*

It is also important to know the sources required for carrying out different operations at various geographical locations and how to handle the logistics. Moreover, for carrying out exploration operations, the ecological effects also need to be taken into account for example interviewee 10 stated that special attention needs to be paid in the Arctic region when carrying out exploration operations as Arctic region is more susceptible to pollution. Thus, the oil and gas companies need to carefully chose their future projects and take into account all these factors when initiating

projects. Also, companies need to be aware of the competitors working in those areas as interviewee 4 mentioned:

"*When you are looking for new developments in a particular part of the world, when seeking funding for development from management team, you have to be aware that you are in competition with other team at different locations*"

Participants further highlighted that the geology of different geographical locations is also unique as this knowledge provides information of what is under the surface and different databases should be made to store the information on different geographical locations. This knowledge is unique as performing the drilling operations in Middle East is totally a different experience than performing the same operation in West Africa or Gulf of Mexico. Interviewee 1 highlighted this as:

"It is not only geographical but it is also types of sub surface ..... So, if you have some experience of working in (for example) Oman, you would be able to work easier or have better understanding of West Texas. So, a lot of companies, have knowledge bases, where they compare the sub-surface between different locations around the world and they actually draw experience… they would bring in people with experience in that context"

Moreover, knowledge related to the political situations is of key importance as companies can put their projects in risk if the situations are unstable as interviewee 8 mentioned:

"*Why many people are coming to North Sea, because political situation is very stable. I was once involved in a certain area in South of Europe, and the states were not so stable. So, for example if you are in Southern Europe, they can announce the session and after 1 year, they will say no,*

no we will not go for that. So, in that sense, yes political knowledge is important for starting new initiatives and taxation etc. It is relevant to political system, if it stable or unstable"

4.2.3 Knowledge of Management

It was interesting to discover that although departing employees might possess the knowledge of management and handling large projects and teams, it was not deemed as important by the participants. According to interviewee 4:

"*It is important but then it again depends on the attitude of the successors. The managers also learned all that what they are doing 4 or 5 years ago, when they got promoted. So, it takes time but you learn it over time. Ok, some of the lessons learnt may be lost but then the new teams are managing the same problems as old teams*"

Management knowledge was considered a bit different from other types of knowledge such as subject matter expertise as interviewee 2 stated that:

"*Management is kind of bit different thing, it is more generic, So, it is less concerned as a subject matter expert field but when you start seeing the technical field, where people leave, that is where true tacit knowledge is and you can have problems. You might see a way of different working style, a different approach or strategy but you haven't lost the true subject matter expertise, technical knowledge because that person is a manager and they have technical people under them. So, it is quite different senior management knowledge loss as opposed to subject matter knowledge loss*"

Thus, this knowledge of managing people is considered less important as compared to other knowledge types such as subject matter expertise and contextual knowledge. It might be

probably easier to replace the managers as compared to technical experts because managers will be having assistants who would know how of all the work flow and thus a continuity is maintained by passing on the history of that work. Interviewee 2 mentioned that there is a transition happening in the company and, thus, people are slowly moving out but there isn't a high impact regarding knowledge loss when people leave from the top management positions. Management is generally seen as facilitator and moreover, not many people can learn those types of skills. Good people skills are also required for this type of knowledge as interviewee 9 mentioned:

"I have seen management people with terrible people skills. Yes, it's a role to facilitate things to be done. But as such doing those things, I don't see management doing it. It is less important as no one has got the job to be done"

Also, it is hard to transfer or retain this type of knowledge as it is a natural ability. A lot of aspects related to management are personality based as interviewee 1 stated that:

"You cannot extract lessons of how to manage different people or how to manage the challenges within workforce. You can do some exit interviews regarding that but it is very hard to ask someone how you manage people"

4.2.4 Knowledge of Train Wrecks and History of the Company

Respondents considered this knowledge as of key importance and such type of knowledge is mostly possessed by senior employees. Knowledge of train wrecks is the reverse of best practices and describe the bad experiences of past, for example, the operations and activities performed in a specific way that didn't work properly. According to interviewee 1:

"*Most people don't admit to the train wrecks; most people cover up the train wrecks all the way up to management but that is where train wrecks get repeated. Because no one has shared the knowledge of what went wrong*"

Similar to this is knowledge of history of company as described by interviewee 4 in which he said that:

"*In 1986, I was working for X (company) oil, and the oil prices died and we had to make the company redundant in a day. We lost about 800 people in 1 day. The management had this process (of handling lay-offs). It is exactly the same process that our managers faced in 2014 when the prices of oil died again. If you have the history of working through that sort of problems, it may not be your responsibility to execute the whole change but at least you can say, hold on, we tried that and it worked very well. I suggest you do something similar now"*

Similarly, it can be something tried in the past but it did not work and thus if employee possesses that knowledge, he can say, we tried this before in such situation and it did not work and thus we should find another solution. This knowledge is useful when newer employees in the organizations are inadvertently drifting along a path discouraged in the past. Thus, this past knowledge of history and train wrecks possessed by senior employees can save time by avoiding "reinventing the wheel". Interviewee 9 stated that this knowledge is important for faults and maintenance issues that occur sporadically for example maintenance schedule of once every 10 years for a plant. So, people who have expertise in such equipment and worked on these in the past will know how to fix these. Similarly, interviewee 6 stated that sometimes, the accuracy and reliability of certain data can be well determined by asking those who were present at the time of

data collection. Thus, knowledge of history of the company and train wrecks, firmly hold its importance for the oil and gas companies.

4.2.5 Knowledge of Business Processes

One of the interviewees emphasized that the departing employees who have worked in the organization for long time might also possess knowledge of different organizational processes and how these are interlinked with each other. This helps in understanding the real value of the business. However, there wasn't a strong consensus on the criticality and importance of this knowledge type. The knowledge regarding different business processes was not considered that important by the interviewees as most of this knowledge is in documented form and can be easily retrieved and used. In large companies, all these processes are well documented and structured and thus there might not be any difficulty even if the experienced employees leave. According to interviewee 4:

"*Procedures on how systems work are written down and are therefore, available for the people to use. Someone else can pick these up and use them"*

Further responses revealed that this knowledge is important if the company has not defined those processes correctly but that normally happens in small companies. So, in smaller, informal companies, absolutely is the number one thing. From the mid-size to the larger ones, most of them have their processes defined on paper already, well documented and everything is almost streamlined as interviewee 8 described this as:

"*This is standard and companies usually have certain directorates of oil and gas by state and they announce certain procedures and accordingly, businesses and systems are defined in the system let's say for small, medium and big size companies*"

4.2.6 Knowledge of Networks and Relationships

There were some interesting opinions on this knowledge type. Some participants considered it important while some said it is not as important from a knowledge retention point of view. However, in general there was a consensus that this knowledge is important for the organizations. Interviewee 6 highlighted the importance of this knowledge by saying that it is like an ecosystem and the equilibrium is affected when an organization loses a person with strong relationships network and knowledge. The results revealed that this knowledge is important because that is how a job is get done and thus an organization needs to know about the departing employee who (s)he worked with and why. For different day to day activities and to perform operations smoothly, it is important to know the main contacts to deal with different matters and to know expert people. Similarly, this knowledge is quite important in technical areas and from tacit point of view as interviewee 2 mentioned that:

"*There might have been three meetings today and none of it is documented. But in a months' time, that person might get called in a meeting to help out in a particular meeting or problem, and there he says yes have heard and understand this from previous meeting. So, if it was just discussed in the meeting and not documented, then you are relying on person what is captured in his head and what he can remember*"

According to interviewee 1, people who are out there in the field have strong connections as he described:

"All those in the field have strong network of relationships. Sub surface is a bit of different, it is very specialized filed. Everyone has a little niche of the field, so they keep it to themselves. But

the engineers and drillers out there, they have much stronger connection. The production people as well. Everyone that is a part of asset in the field has a stronger connection."

Interviewees also stressed the external networks of relationships along with internal networks. For example, if the employees working in Gulf of Mexico encounter a problem, they will approach other people working in Gulf of Mexico for solutions rather than people from other locations. Moreover, this type of knowledge is also important to handle the governments and regulatory contracts. Companies can get into trouble if they don't have the right permits to operate. According to interviewee 9:

"Local governments, regions, national governments, you need to know the regulatory mind field in order to operate and the right people to contact. You cannot operate without knowing environment regulations, industry regulations and government procedures"

However, interviewee 4 had a different opinion about this knowledge of relationships as he stated that knowledge of relationships is something personal. He opined that:

"Your network is the individuality of yourself. And your relationships are individual to yourself. You kind of create those. The fact that I get on really well with somebody, doesn't necessarily mean that it's going to be of any use to next person coming in. That is a waste of time. That is how I approach it. Other people may approach it differently"

However, most of the participants disagreed with this that previous contacts are of no use. Responses revealed that most of the activities these days are team based activities. So, in these teams, there are always younger people to participate and assist along with the experts who have experience and contacts. So, in this way younger people learn about the work and different

contacts through participation and that is how the knowledge of relationships can be propagated. Interviewee 9 was of the view that:

"The list of previous role holder's network could serve as a starting point for a new person in building the relationships"

The results further revealed that knowledge of relationships depends heavily on job profile of the person and his involvement in various operations for example employees in business development and supply chain areas tend to have a stronger and more interactive network of relationships as compared to other areas.

4.2.7 Relevance of Knowledge

The previous section describes the different types of knowledge that are critical and need to be captured from the departing employees however; another important factor to be kept in mind is the relevance of this knowledge as interviewee 1 shared that:

"*You need to put together a risk assessment profile overall in the corporation as related to skill set and dependency on that skills set. Then you can go after the individual that might be relevant because larger corporations have too many people to do it on individual basis. That's where a competency model is very important to know where everyone is from an expertise point of view and then say ok we have you know 1 senior reservoir engineer at level 5 and everyone else is at level 3 that is a risk for our organization. So, we need to focus on the knowledge transition in that specific area*"

Interviewees were of the view that an active 'scanning the horizon' for trends of technical and business practices will help. Moreover, there is also need for good understanding of probable

future projects. The scope and relevance of knowledge might also differ depending on the location for example interviewee 8 mentioned that:

"*Ideally it should be based on the knowledge for that process. You have big companies, small companies and you have different processes within. You have offshore, onshore. Now in specialized technical knowledge, you might have difficult fields or easy fields. Middle East has easy fields. You have one well in Middle East and for that one well in Middle East, you have 10 wells in the North Sea. But in United States, you have 100 wells in the same area. So, in Middle East it doesn't matter that much but in United States you need to have a knowledgeable guy who can predict drainage, and so on, so they will try to keep this guy. So, it depends on this area which we talk about and according to that, you have to do most out of it*"

It also depends on the goals and strategy of the company and can involve taking into consideration multiple factors as stated by interviewee 6:

"*What could be considered today a critical knowledge it could not be the same tomorrow. And what is considered today less important as knowledge could mean to lose a fantastic opportunity for tomorrow, we could think of a multi-dimensional model with the following dimensions: the age of the personnel, the employee satisfaction, the time, the velocity at which a knowledge becomes obsolete, the business objectives, etc. It depends mainly on the company's strategy. The fact is there are few companies that are really able to identify and value their critical knowledge. And when I speak about critical knowledge I refer mainly to the critical people*"

5. Analysis and Discussion

A lot of people in oil and gas are near retirement age making retirement a major factor of knowledge loss (Ball and Gotsill, 2011, McKenna et al., 2006) in oil and gas in upcoming years. In that case, it is easier to make some strategy and assess the knowledge of the employees as the organizations know in advance about the departure of the employee. Also, it becomes easier to identify the critical areas of the knowledge loss from the employee as his knowledge can be broken down into several domains depending on which areas they have worked in the past years. Therefore, it becomes important to understand how the companies and managers think about the knowledge loss assessment processes and whether these should be carried out or not. Conducting such a knowledge risk assessment requires the active involvement of all managers throughout the organization (Calo, 2008).

Succession planning seems to be very easy in theory. Precisely knowing what critical knowledge needs to be transferred is the challenge. Critical knowledge is related to the fact that lot of methods being used in companies are owned and being patented by those people who have worked in the company for long time and have huge experience (Daghfous et al., 2013) emphasizing the importance of senior workers. Regarding the critical knowledge areas, six knowledge areas were identified by the interviewees which the departing employees might possess. First one was technical knowledge which involves handling all the core business no matter what discipline you are working in oil and gas. So, it can be broadly termed under subject matter expertise falling in line with the findings of Joe et al. (2013) who take subject matter expertise tied to skills, knowledge and experience of individuals and might involve strategic, operational and scientific knowledge. This knowledge, as described in results, might reside within different functions of oil and gas such as exploration, reservoir management, drilling,

production, maintenance etc. In bigger companies, there are research groups as well looking at new types of technologies and thus the employees working in these research groups might possess the relevant subject matter expertise. The importance of knowledge of networks and relationships is well versed in literature and it matters a lot for the business performance (Groth, 2003, Inkpen and Tsang, 2005) and getting the job done by knowing and contacting the right persons. This knowledge was considered equally considered important in oil and gas sector as evident from the results. People in oil and gas are all dependent from a knowledge point of view to share and learn but when it comes to a pure network of people, the guys in the field might possess a stronger network as they have bee interacting and working with people at different locations throughout their career. They will not stay in the field, they eventually become managers but that relationship with the people stays for the rest of their career. This network eventually helps in locating the right contact and referring colleagues to the right knowledge source when required (Joe et al., 2013). Moreover, organizational and collective learning is enhanced through social and cultural networks (Daghfous et al., 2013). Also, external networks are critical especially in oil and gas when different projects are initiated and companies need to interact with the local bodies and governments regarding different regulatory requirements (Fisher and White, 2000). The trust element is of critical importance in relationships and networks (Hohenthal et al., 2014). When trust is developed through healthy relationships; employees would trust anyone that they have worked with and value their opinion than any other expert. So, it also provides a hint, that may be the knowledge of relationships and information about important people can be captured, the trust element is missing there and eventually, the relationships and network prove to be linked to individual person not the company and as long as the employee is working with the company, he might use his relationships for getting thigs done

but after he leaves, that network of relationships might not be that much effective for the company.

The knowledge of management is unique and can't be captured as revealed from results. This knowledge is important but either you can keep the departing employees to utilize this knowledge or the successor can be trained using some training and workshops to improve his management skills (Mintzberg and Gosling, 2002), as management is something natural and every person has his own way of handling the people and projects. Aspects like ability to engage people personally, quantitative intelligence, competitiveness etc. are innate qualities (Elmuti, 2004). The new manager might take some time to catch up and improve his skills through practice. Thus, if possible, it is better to choose a successor who has management experience before and to use the concept of job shadowing as the junior employee can work with the senior employee and then learn these skills. The contextual knowledge is very relevant and pertinent to oil and gas industry as it is an international industry where employees keep on rotating and work at different locations around the world (Inkpen and Moffett, 2011). Each part of the world does the job slightly differently because the culture and the infrastructure in that area. It involves the political knowledge, cultural knowledge, environmental knowledge and to be aware of different constraints across varied geographical locations (Brunold and Durst, 2012). Thus, knowledge related to these aspects is critical and should be retained from departing employee. Companies can compare knowledge bases where they compare sub-surfaces across different geographical locations and draw experience from these knowledge bases to determine the best approaches to perform operations. The political stability of the location is also of key importance as the delays might occur in the processes if the situations are unstable. There might be stoppage in the operations resulting in loss of business and money and lives of the employees might also be at

risk. Another important knowledge type to be retained from departing experts is knowledge of all the bad experiences or train wrecks. Normally the companies keep record of best practices, however, these bad experiences also need to be shared so that they do not get repeated as interviewee 4 provided a good example about handling the downturn in 2014 using the experience of 1986 economic crisis. Of course, such knowledge resides with the experienced and aged workers thus emphasizing their importance.

The resources of every company are limited and thus organizations need to prioritize to work on knowledge that is critical now and critical in future. It depends how well spread are the subject matter experts related to different knowledge domains. If there is only single point of contact regarding some specific area, then the company might be in trouble upon his departure. Thus, the number of replacements available for a departing employee determines the relevance and criticality of knowledge. Thus, when taking measures to retain knowledge of departing employees, several factors need to be considered such as, how good is the network of employee, how often he meets with people, how long he has been working in the organizations and at what positions (Jennex, 2014). Thus, it is quite a challenging task if a proper knowledge assessment needs to be performed. The focus must always reflect the organization's goals or strategy in future (Leibowitz, 2009) . Every person has a job description and job specification. Also, he will have a series of task (s)he will be working on since they joined the company. Moreover, as evident from results that the location of the organization also matters in terms of knowledge relevance. Thus, it is also required to do assessment from an economical point of view because doing economics in the Middle East is different from doing it in Antarctica or in more sensitive areas such as Africa. So, all these factors of relevance and context are important for assessment. Thus, this discussion reveals interesting insights on the relevance and importance of six

identified knowledge types. An employee might possess all or some of these knowledge types, and managers and executives need to carefully perform an assessment of the employees' knowledge taking into account all the above discussed factors.

6. Conclusion

The oil and gas industry is facing an aging workforce issue due to which the knowledge loss due to retirements is inevitable in near future. The study highlights this issue and focuses on the identification of different knowledge types possessed by departing employees. Six main knowledge types have been identified in the context of oil of gas sector. The major knowledge types to focus on are specialized technical knowledge, contextual knowledge of working across different geographical locations, knowledge of relationships and knowledge of history of the company. The outcome of this study has several important implications.

Knowledge Retention of Critical Employees: The study brings attention of managers and executives in oil and gas industry to knowledge loss from departing employees. Oil and gas companies need to focus on the knowledge retention especially for retirees. Moreover, due to current economic situations, the companies are also firing employees most of whom are experienced employees. Thus, this study calls for attention of managers and executives to think about this knowledge loss and more than that, it requires the management to take proactive role in retaining the knowledge of these experts. The most important employees in terms of expertise are the experienced and seasoned employees working in the industry and they possess variety of knowledge types as indicated in the study.

One-One mapping of critical knowledge: It is evident that organizations need to break down the profile of the employee according to different positions and expertise he has gained over time.

As an employee might possess various types of knowledge, it is important to have one-one mapping of critical knowledge. This will help in identifying the closest person with similar knowledge and skill set who might be the suitable replacement for the employee or to whom knowledge of the departing person needs to be transferred. Relevance of knowledge as discussed above needs to be kept in mind as the previous knowledge might be or might not be important for organization and thus one-one mapping needs to be performed accordingly. The list of critical knowledge types can be checked against each employee. After the knowledge type for departing person is identified then, the relevance of that knowledge can be checked. All this work needs to be performed by the manager of the departing employee with assistance from the peers of the departing employee as these people knew and worked with the employee and thus can truly identify and evaluate the knowledge of the person.

The study also has limitations. The focus area is only oil and gas industry and research in other industries might reveal some more interesting insights on types of knowledge possessed by departing employees especially manufacturing industry which is also facing an aging workforce issue and not much new people joining this industry. Further research can be conducted on developing a knowledge loss assessment framework based on the knowledge types identified in this study. These six knowledge types can be incorporated along with the major likelihood factors of knowledge loss for example, retirement, turnover, job rotation etc to develop the knowledge assessment framework. Moreover, it would be interesting to see the impact of these knowledge types in different industries for example relevance of each knowledge type according to different industries.

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Appendix

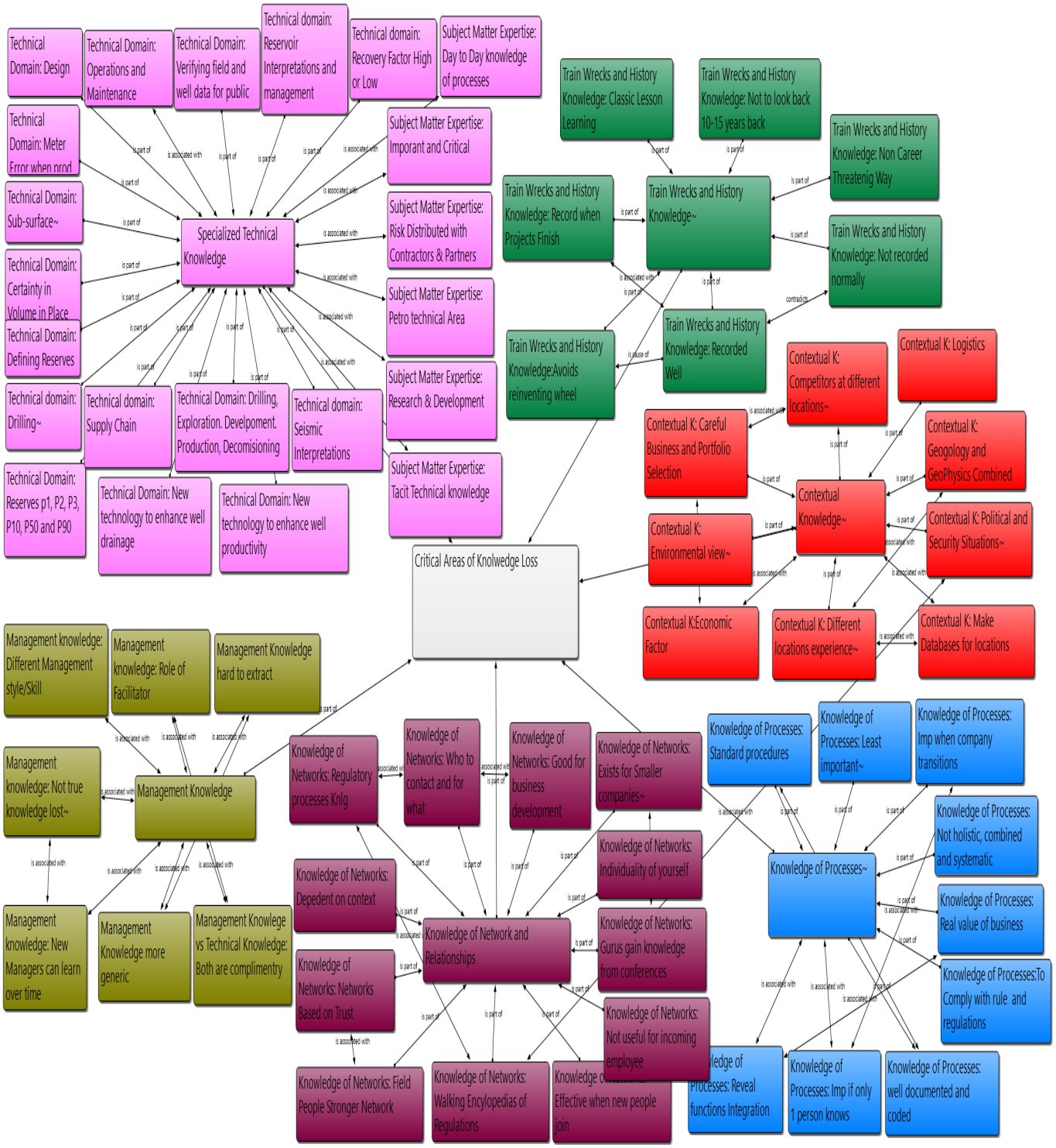

Figure 1: Network View for Critical Areas of Knowledge Loss in Oil and Gas Sector