Master's degree thesis

LOG951 Logistics

IMPROVING INFORMATION MANAGEMENT FOR INCREASED SUPPLY CHAIN PERFORMANCE

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1 Preface and acknowledgements

This thesis is written as the conclusion of the experienced based master course in logistics at Molde University College.

My sincere gratitude goes to my supervisor Bjørnar Aas, whose insights and feedback have been invaluable for my delivery of this thesis, and for that I am very grateful.

PhD student Anastasiya Karalkova has also contributed with some very good insights and helpful advice.

I also owe thanks to many of my colleagues who have contributed with their knowledge and insights into all their different fields of expertise. Though they are too numerous to mention here, I would like to name the most prominent contributors in a random order, and these are:

Thomas Aandahl – OCTG manager, Tore Skalde – team lead logistics support department, Svein Silseth, Deputy director and Terje Nilsen – IT responsible

Having worked at Vestbase for 20 years I still find there is much to be learned about the company and this information would not have come easily if it had not been for these individuals.

Kristiansund 19th of January 2014

2 Abstract

The Norwegian oil and gas industry stands before a major change in its approach to logistics and supply chain management.

This thesis looks into challenges faced by both participants in the local supply chain at Norway's busiest supply base Vestbase, as well as at the overall and industry wide supply chain, trying to answer some simple but important questions regarding long standing information management issues and problems with necessary data collection.

I have studied Vestbase's current methods for data collection to try and seek out new practices in this area, in order to improve how information is managed, and through this, make some suggestions as to how Vestbase can improve its performance on its contribution to the supply chain. Following the accepted academic standard for case studies, a number of interview questions were used in combination with informal conversations, internal documents and archived data to analyze the current state of affairs at Vestbase. The study led to several suggestions for new routine implementations through the development of software program modules for logistical and operational support, both internally in Vestbase as well as in direct connection with several of its supply chain partners and their systems.

The text concludes that Vestbase and several of its fellow participants in the industry have a great potential for improvement by increasing efforts in computer software development for better handling of data outside of the individual companies' standalone ERP systems. There are also indications that Vestbase will benefit from becoming more involved in the future development and implementation of logistical software modules connected to the upcoming common event database LogisticsHub. The result of such an effort could give the company a closer and wider integration with the oil and gas supply chain in Norway.

Resulting benefits of these efforts should increase system efficiency and effectiveness, reduce cost, increase information availability and give better operational reliability. It should also lead to increased Health, Security, Environmental and Quality standards and greening of the supply chain. The text also indicates that, as a supply base company and integrated part of many other companies' supply chains, Vestbase stands to benefit from taking the lead in the development process, both for improving its own internal supply base logistic, and, on a more long term and strategic level, strengthening its position as the industry leader in upstream logistics and supply chain management services.

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6 Introduction

This part of the text describes the focus company, its history in the oil and gas industry, and the background for the chosen topic.

6.1 Main research problem

The aim of the thesis is to contribute to answering the question:

“How can the way information is managed be changed to improve supply chain performance, in a way that benefits Vestbase?”

As a backdrop to this, a definition of the term Information Management is introduced as: *"The economic, efficient and effective coordination of the production, control, storage, retrieval and dissemination of information from external and internal sources, in order to improve the performance of the organization"*(Best 2010).

In practice, it is proposed that finding an answer to this problem could lead to several improvements that include such points as reduction of non-value added work, improved data quality, (which both should lead to better supply chain performance), higher revenues and also, improved company influence, reputation and image in the industry.

At Vestbase, information sharing with key personnel at the lowest hierarchical level has been tried on a small scale in order to move the actual electronic registering of information from office personnel to operators working in the field. This has proven successful and there are some expectations in the company as to whether this can be escalated to include a bigger part of the operational efforts.

Creating one or more proprietary software tools for data collection is relevant, as the company is eager to develop itself through such innovations. Several software systems have already been developed by the company, and at least one more has been commissioned. This indicates that there is a good possibility that the result of this thesis will be of interest, and that it will support further innovation and development.

As an example, one recent idea has been to electronically share data on incoming customer orders with the work teams in the field. The data can be pooled and made available through information devices, so that anyone with access to the system will be able to pick up individual work tasks that fit with the teams’ composition and location.

This has already been tested on a smaller scale with forklifts on very simple orders that don't need any planning or interaction from middle management, and this has proven quite successful. Extending this to work teams and foremen through a more complex and versatile software tool is relevant.

There could be some scientific contributions here too, since literature search shows that little research has been carried out focusing on supply base logistics. Within the industry it is commonly accepted that the actors still have a long way to go in terms of logistics innovation and resource utilization.

6.2 Goal and objectives

The main goal of the thesis is to show application of theory on a practical, real life problem, and to apply attained knowledge in order to improve supply chain performance.

The main objectives are:

- ***To investigate which tools that are already in use and can be better utilized for the purpose of improved information collection***
- ***To analyze the introduction of possible new tools based on information available in existing systems/databases***
- ***To find a good heuristic for implementation of such tools***
- ***To find any restrictions, such as incompatible software systems or access to services vital to system functionalities***

The main backdrop here will on the whole be the connection with information management and its importance to Vestbase as well as relevant members of the extended supply chain. In this context, the text will typically include operating companies, transporters, supply ships, other supply bases and 3PL's (third party logistics providers) operating in the industry.

The thesis will be looking at Vestbase's existing resource allocation system (RMC - Resource Management Coordination) as well as several of its other software systems currently in use.

RMC is one of the most important tools used for coordinating daily operations in the field at Vestbase and the possibility of using RMC's underlying database as an extended tool will be explored. Pooling of work activities and accessibility through available technology is the underlying theme. Other systems that are currently in use will also be scrutinized to see if there is room for improvement.

Another side of this text will be to look into other, more unexplored possibilities that might be available to the company in terms of systems development and information management.

Being able to create a solution for improving information management is important, and the main reason for defining this problem is that better information management should lead to fewer errors, an improved decision base and thereby more accurate and up to date information.

This should reduce non-value added work and associated costs, as well as contributing to higher efficiency and improved supply chain performance. Another resulting effect would be to resolve a long standing issue in the company, namely collecting on accounts receivable.

Outstanding debts are often large and are giving the company a certain financial challenge on its accounts receivable that it could do without. The problem is a comparatively large credit issue regarding short term debt, which includes housing rent and salaries, due to a relatively large pre invoice work order build up.

6.3 Delimitations

The text will be simplified to a level of detail that will make it readable and at the same time be extensive enough to support its findings with sufficient academic work. This will be done without exceeding an acceptable volume, and the text will be limited to seeking improvements that can be done within the constraints of the current financial environment in the company.

The thesis will have its main focus on information management, both in regard to existing systems and on future systems that may come to life in a more outward and customer related way. The scope will be limited to looking at Vestbase's current software systems as well as one up and coming business wide information management system that is currently being implemented.

The scope is potentially large; therefore it is limited to looking at Vestbase's role in the upstream part of the supply chain. Solutions may naturally include implementations that are suitable for Vestbase's parent company Norseagroup as well.

It is natural to keep the research limited to possibilities that exist within the industry category of onshore supply bases and related connections. Any findings that may be relevant but not paramount to the quality of the thesis will rather be mentioned as further work for future reference.

6.4 Company description

Established in 1980, Vestbase has gone from being a supplier of simple logistical services to companies in the Norwegian oil and gas industry, to becoming an integrated part of several major oil companies' supply chains and it is currently operator of the busiest logistical hub for the oil and gas industry in Norway.

Since 1980 until today, Vestbase has grown substantially, from about 40.000 square meters of outdoor storage and a single warehouse with some adjoining office barracks, to almost 50 different types of warehouses and office buildings and 600.000 square meters of outdoor storage (Taknæs 2013).

The acquisition by Aker Maritime in 1993 into Aker Base (Krav 2003) was an important milestone in the company's history, and marked its entry into a new direction when it came to enterprise planning and strategic management. Vestbase was later incorporated into the Norseagroup Corporation, which is the largest offshore supply base operator in Norway. The corporation delivers a wide range of services, according to its own statement (Norseagroup 2014);

'The NorSea Group organization has been established to provide a broad range of regional businesses support functions and specialist professional services to the oil and gas industry.'

- Quay facilities with multiple shipping services and bulk products
- Total integrated logistics for support of drilling campaigns
- Waste management
- Terminal services
- Property development, property rentals and facility management
- Coordination and management of supply ships
- Marine logistics and marine operation planning
- Market screening, tendering and vessel selection

The Norwegian Shipping company Wilh. Wilhelmsen is the newest partner in the corporation, and is for now mostly on the owner side to get a foothold within the offshore supply industry (Skalde 2012).

The new partners that have come since 1999, which are all shipping companies, have been and intend to continue to take Vestbase, through Norseagroup, into a new era of solutions provision.

The three shipping companies add maritime and international knowledge and experience to Norseagroup and this provides for a solid base of operations in its daily work, as well as for future expansion prospects.

Over the years, the company has acquired a lot of knowledge in regard of the industry's inner workings, especially when it comes to its atypical logistical situation and maritime connection.

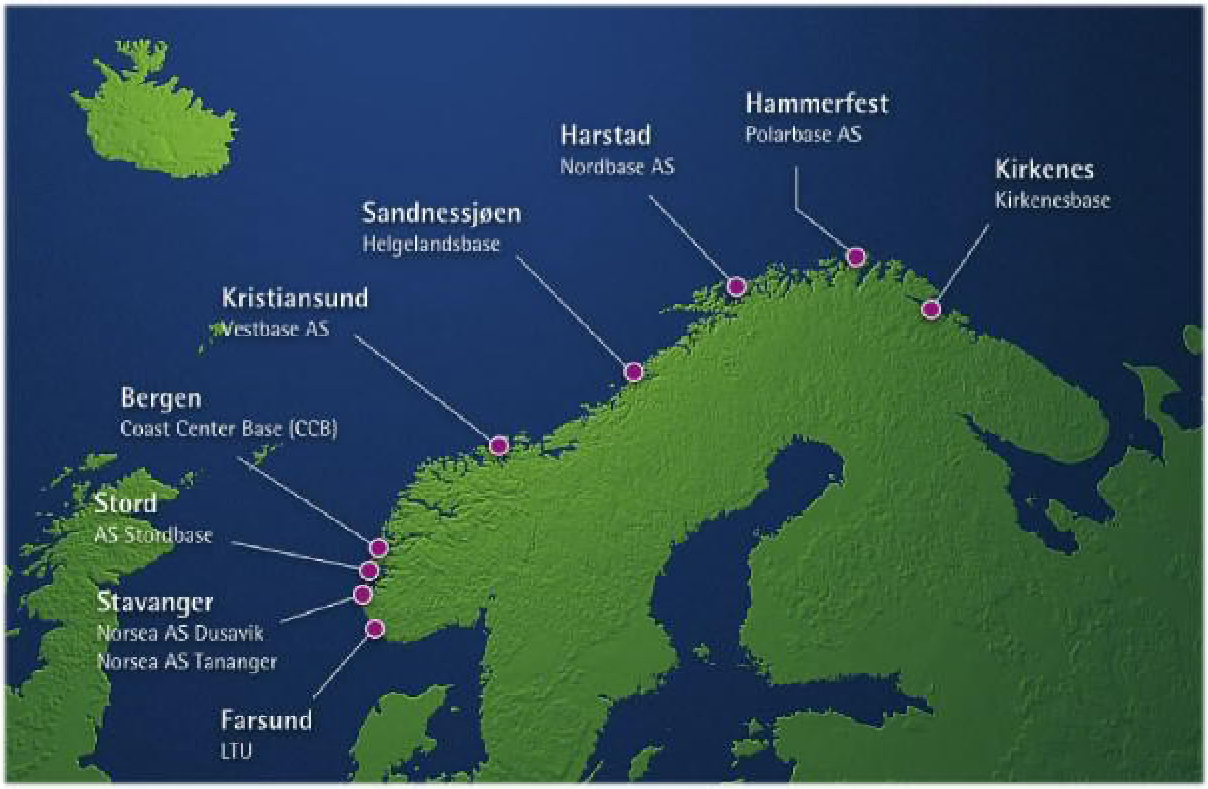

Figure 1 Vestbase as part of the Norseagroup enterprise (source: Norseagroup AS)

This knowledge has given rise to the development of a number of different services from the company. The increased competence has also enabled Vestbase to go from being a reactive supplier to a proactive contributor within the industry in terms of innovation and development, both when it comes to service deliveries on general oil and gas related products (materials handling, packing of goods, loading supply ships, warehousing etc.) as well as property management and warehouse and office subletting.

The services supplied at Vestbase are varied and below are some of the products available to the over 60 companies located both within and outside of the supply base area:

- Ship Chandler services
- Wire production
- Tank and Container leasing
- Waste management
- Tank cleaning
- Marine Gas Oil, LNG Nitrogen, Methanol and misc. drilling fluids
- Welding and manufacturing tool shop
- Sub Sea equipment maintenance
- Rig and Suezmax docking and maintenance
- Miscellaneous Engineering services
- Technical services including Non Destructive Testing and lifting gear inspection
- Electrical services
- Oil spill handling personnel and equipment
- 3PL Transportation and customs services
- Preservation and surface treatment services

Figure 2 Aerial view of Vestbase (source: Vestbase AS)

It should be clear that the supply base also is an industrial service area and many of the contributing companies therein demand logistical services from Vestbase in many different ways.

6.5 Supply chain contribution

Since 2006 Vestbase has been trying to adapt to a steadily increasing speed and complexity in its daily operations as well as coping with an increased scope of work, by trying to utilize its current bundle of software in a more efficient way. However, the current systems do not seem to fully cover the need for accurate information management and adequate planning horizons.

Increasing customer demand, management needs and other stakeholders' expectations are all factors driving the company towards innovation and adaptation of new methods and systems. As a natural response to these demands, the company has learned to use these challenges as opportunities to improve its own contribution to the overall supply chain through innovation and change.

As mentioned, Vestbase constitutes an important part of many companies' supply chains, and has to conform to the different supply chains' structures, so as to operate as if it is an actual member of the many different customer organizations. It is therefore of importance that the company is able to continue to have and maintain this role and, consistently, deliver high quality services, including data for information management, including invoicing and reporting to its customers.

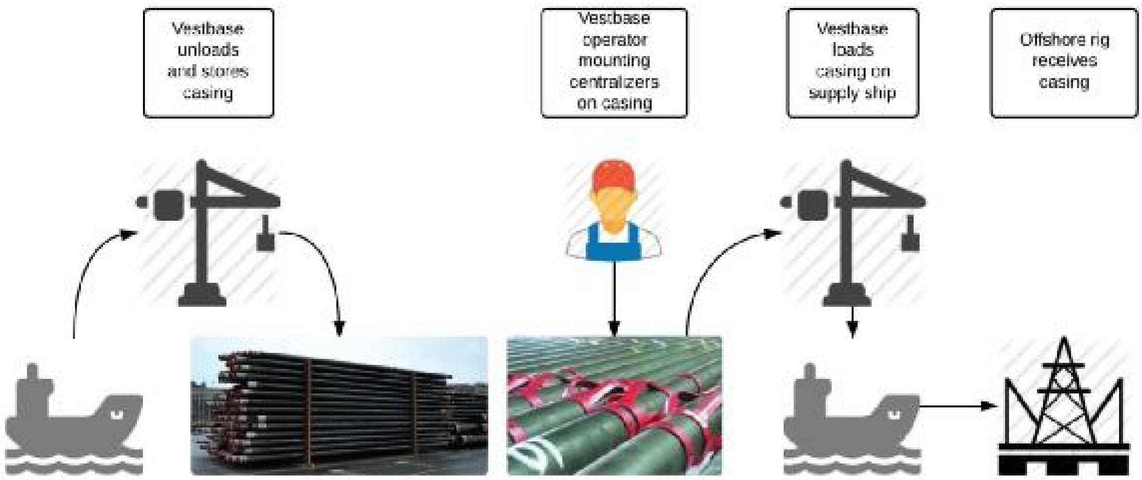

Figure 3 Vestbase supply chain service 1

There are numerous tasks performed by Vestbase personnel every day, and Figure 3 shows how the company supplies both unloading, warehousing and decoupling (final modification of product before use) services for oil companies. Vestbase has the tools and knowledge to receive large quantities of steel pipes and both handle, store and make final preparations on these pipes before shipping offshore.

Another example of service delivery from Vestbase to its customers is one of the tasks performed by its technical department. Here, competent personnel will do a final checkout of cargo containers for compliancy with regulations before they are loaded on the supply ships.

Figure 4 Vestbase supply chain service 2

'IT is a tool that can aid information management (IM) and speed up the information flow thus making the supply chain more robust and resilient without undermining its efficiency.' (Pereira 2009)

According to Pereira, implementing IT tools for helping information management can improve the supply chain. The effort done by Vestbase in this area will, if it is done right, contribute to improving the supply chain through more accurate historical data as well as real time operational data for end user decision making. There will also be ample amounts of information available in an electronic format that can be shared with other supply chain participants, thereby increasing Vestbase's contribution to the overall supply chain.

Vestbase has not been able to utilize its ERP (Enterprise Resource Planning) system in the traditional sense, and as a response to this, the company has commissioned several supportive software systems to provide end users further down in the hierarchy a better way to collect operational data for invoicing as well as to give management and customers an improved decision base.

For instance, in 2010, Norseagroup bought an information tool called Corporater - an enterprise performance management system used to collect data from any database, enabling drill down (looking behind a summary of information) as needed. This tool has proven very effective for Vestbase when gathering operational decision data (shown in Table 1, the numbers show revenues from a selection of customers in thousands of kroner (numbers have been adjusted for anonymity)).

	January	February	March	April	May	June	July	August	September	October	November	Desember
	15 873	**17 396**	**12 577**	**16 510**	**23 655**	**20 443**	**20 364**	**18 913**	**14 681**			
Cust. 1	741	3 976	3 262	4 511	7 487	6 958	6 269	3 566	4 723			
Cust. 2									72			
Cust. 3	13 026	13 418	9 312	8 989	11 864	12 390	13 235	15 344	9 882			
Cust. 4	2 104			1 905	4 300	1 092	858					
Cust. 5				1 102								

Table 1 Corporater database drill down (source: Vestbase AS)

The potential for improvement and cost saving is seemingly large since Norseagroup operates nine supply bases in Norway (and now, one in Scotland) and small changes could make for large improvements both on the operative and enterprise levels. This goes both for HSEQ (Health, Security, Environment and Quality) and financial savings, for the company itself as well as for its clients.

A prerequisite here is that Norseagroup is able to share collected data through sharing of best practices throughout the entire enterprise.

6.6 Background

Vestbase is having problems with information management. The company has for several years been trying to change this but is not making enough progress, and is using too many resources to run the existing IT systems something which is not financially acceptable.

Training coordination staff and increasing the number of people working with information management to gain better overview of the situation has not led to adequate improvements. It is therefore necessary to look at other alternatives than the ones that have so far been explored, and one aspect that has been discussed is to change how IT tools are used and implemented.

It may be that software based logistics solutions has not been integrated and utilized to its maximum potential in the company yet and the authors view is that there is room for improvement. Investigating different ways of utilizing current and easily available technology to improve data collection seems very interesting, and it should be possible to find a good model for change within the company and among its human resources.

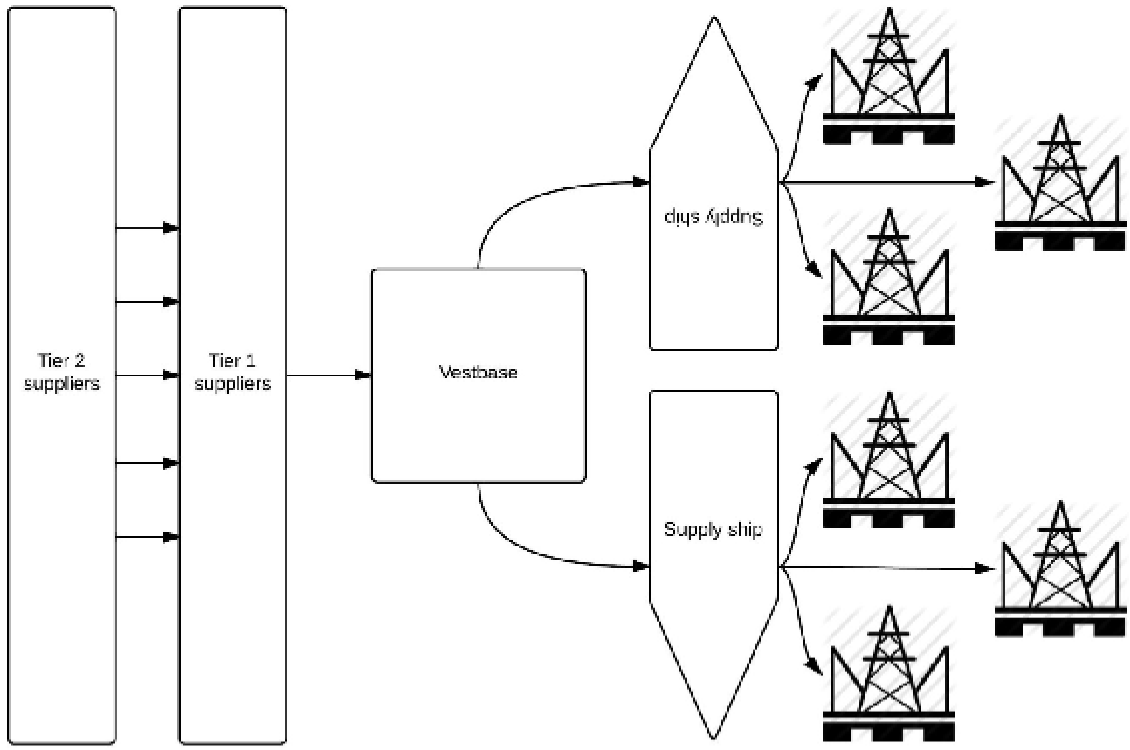

Figure 5 Simplified supply chain setup at Vestbase

As mentioned, Vestbase makes out an important part of many companies' supply chains (see Figure 5). And the more than 60 companies that operate within the main base area are served by the company on a daily basis.

This is an indication of the work load that the company has to deal with when it comes to internal transport missions and lifting jobs. Cargo is moved by the hundreds of tons every day and Vestbase delivers a whole range of other services as well.

The main services Vestbase delivers today include:

- Loading and unloading of a variety of ship types
- Internal transport of cargo on the base area
- Technical services on lifting gear
- Maintenance and preservation services
- Bulk deliveries to and from ships
- Freight forwarding
- OCTG services (Oil Country Tubular Goods - steel pipe for lining oil wells
- Decoupling services
- Office and warehousing services via subletting and personnel inhousing
- Deep-water quay facility for drilling rigs and Suezmax shuttle tankers
- Property management

As a result of this variety, the jobs performed on the base area can vary a lot in size, duration and complexity. A single job can last from 10 minutes to a week or longer. Any job may require from one person to many people of different professions and may also involve the use of several other utilities. These include cranes, forklifts, MAFI trucks, pipe loading rams, trolleys, lifting gear, miscellaneous rental equipment and other tools and items as needed.

Figure 6 shows the 2.5 kilometer long area that Vestbase operates. On a normal day, there will be from 10 to 20 different ongoing jobs and jobs in planning that require work teams of varying configurations. During a day, the total number of jobs performed by these teams average 100 (Øien 2013).

Figure 6 Map of the base area (source: Vestbase AS)

The work teams' configuration will usually change several during a single day. The changes are either ordered by coordinators at Vestbase's customer center or the work team leaders. Keeping track of these changes is a difficult task, as every change has to be communicated to the customer center coordinators, via such communications channels as VHF radio or mobile telephone.

There are six coordinators that handle these tasks at the customer center plus three that handle special requests from subsea service and anchor handling ships. Even though all of these persons may take part in the customer center's regular activities, the information flow through the office is comparatively very large and seemingly too much to manage in a qualitative good way, with the current system setup.

To clarify, the customer center handles job tasks that involve transport of goods around the base area, packing of goods that can't be handled easily by hand or forklift and loading and unloading of supply ships.

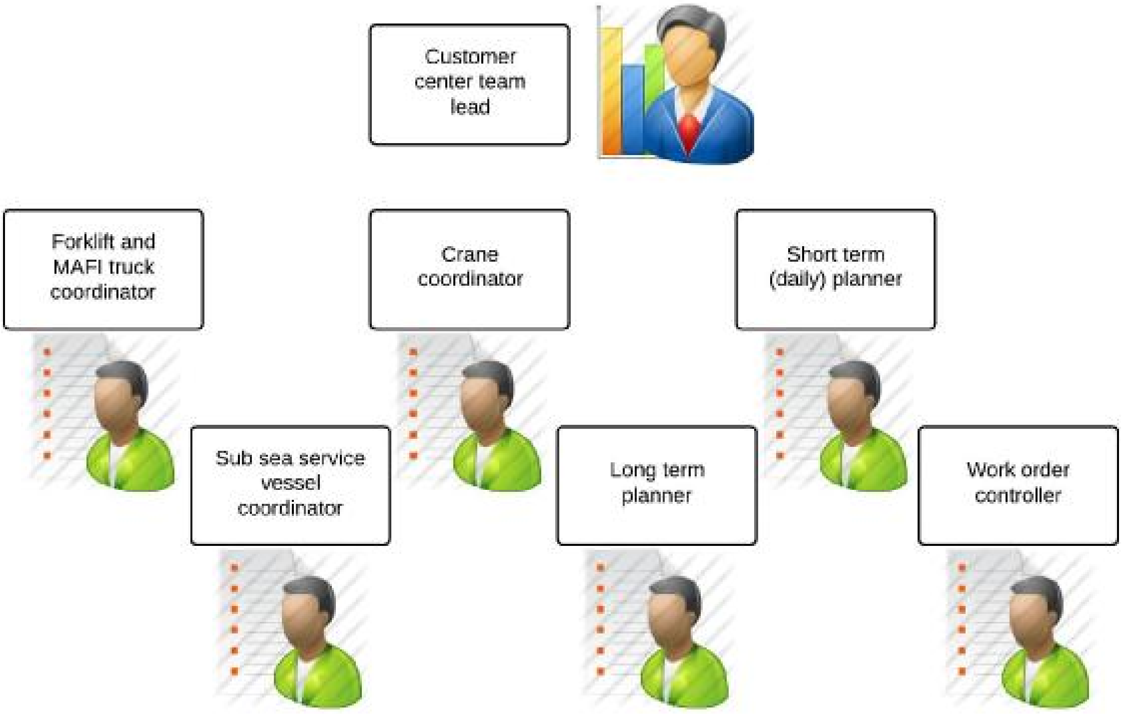

Figure 7 Customer center personnel configuration

The customer center actually only consists of nine people – all office staff - and has to draw on resources from Vestbase's base operations department which delivers personnel, cranes, forklifts and MAFI trucks to execute the jobs. The normal setup at the customer center is five to six people (Figure 7), with duty personnel arriving in the afternoon to take over operations and one to two people on short leave due to long shifts and overtime work.

6.7 The micro view / service monopoly

Being able to handle its own internal supply chain activities more efficiently than today, will naturally have positive influences on customers supply chain performance too, as there is clear interdependence between Vestbase and most of its customers in this respect. These interdependencies may also have some indirect economic consequences, as errors in invoicing data causes a lot of communication between Vestbase and its customers.

Vestbase has a monopoly on transportation services in the industrial park and any company that needs to move goods between their own warehouse and their customers' facilities must use Vestbase's transportation services. Many of these transport missions are paid by the hour and Vestbase's intention is to perform in an efficient manner to reduce customer expenditures and to stay competitive.

Some contracts stipulate a by the ton handling price of goods and the incentive for Vestbase to increase efficiency is even stronger here, as less resources spent on these activities means higher profit per ton cargo loaded.

6.8 The macro view / available resources

External factors play a role as well, and some of these variables include the following points to be taken into account:

6.8.1 Resource forecasts

Considering the current knowledge of the level of oil and gas resources on the Norwegian Continental Shelf (Figure 8), it is clear why the industry wants to become better at supply chain management / logistical activities. Hydrocarbon resources are finite and will be spent, and the more hydrocarbons are taken out, the higher effort is needed to acquire the remaining volumes (NPD 2013a).

Also, it is becoming increasingly difficult to find new, large deposits of hydrocarbons in mature areas and known resources and reserves are decreasing (see Figure 8). Areas like The North Sea and Haltenbanken are mature or maturing, meaning that smaller field development are the most frequent type of projects. These are often done by tie-ins and satellite production, connecting these fields to larger installations.

(Tie-ins are production wells having their crude oil and / or gas production stream routed to an already existing production platform through pipes to make production cheaper by utilizing the existing production capacity).

The smaller the field, the more call for low cost operations during development and production. These factors call for reduced expenditure in all fields of the industry, including logistics and supply chain management and thereby Vestbase's supply base activities.

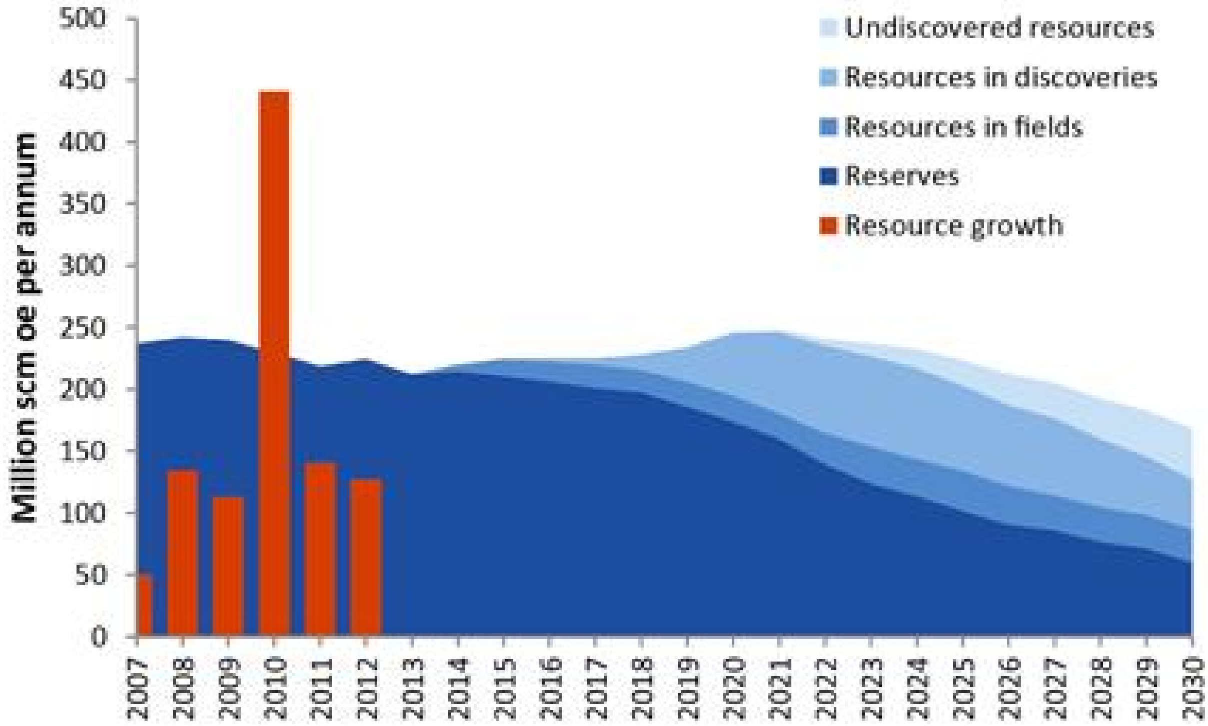

Figure 8 Resource growth on the NCS (NPD 2013a)

6.8.2 The entire potential

On the other side of this situation - looking at the total surface area of the NCS (Norwegian Continental Shelf) (Figure 9) which is about 2.000.000 square kilometers (NPD 2013b) - much larger than the total area of The Gulf of Mexico which is about 1.500.000 square kilometers (Atlas 2013), the situation seems to have more potential. It is unclear how much resources lie hidden in this vast area but the information does provide a certain idea of the potential for growth in the industry.

This scenario points in the opposite direction and if the potential becomes fully utilized, one has no difficulty seeing how Vestbase and Norseagroup would benefit from having a better and more streamlined way of performing its core activities in the future. There is also much more competition in this part of the industry today and its major participants will most likely demand an ever higher level of supply chain integration and logistical efficiency in the years to come. This will most likely put even more demand on supplier performance.

Figure 9 Area status for the NCS, June 2013 (NPD 2013b)

6.8.3 Succeeding text

The thesis will include a section where theory is combined with the findings from the data collection, seeking to find support for a viable path towards a solution to the main research problem (Chapter 8.9). The rest of the text is structured as follows.

7 Research design

An exploratory research design will be used in the investigation process. (Hart 1998) says that this method is good for providing better understanding of a subject and to shed more light on a process or problem. The main method will be the use of interviews, where persons who hold information relevant to the research problem will be given a set of questions to answer. Interviews can be used for data collection to reveal the richness of people's views based on their different roles in the organization (Stuart et al. 2002).

The interviewees in this thesis are working in different departments and on different levels so this seems appropriate here. Some archive data and field observation will also be used. The resulting empirical data will be applied to try and answer the questions mentioned in chapter 6.2.

The reasons for choosing this approach are that the kind of computer systems used at Vestbase for data collection is relatively new to the company and (Blome and Schoenherr 2011) states that case studies can be beneficial in cases with recent changes. The reason for this is the richness of information and the ability to answer 'how' and 'why' questions.

Also, (Ellram 1996) and (Blome and Schoenherr 2011) (referring to Gibbert et al., 2008 and Yin, 2009) both refer to this approach as applicable data collection techniques in qualitative studies. (Eisenhardt 1989) supports interviews as a key data source in the case study approach, as does (Ellram 1996). They both also support multiple data collection methods which include participant observation and archive information. The explanatory research model will also be applied in the solutions part of the text in chapter 10.

7.1 Research Design Quality

(Ellram 1996) states that; *'Good research design requires external validity, reliability, construct validity, and internal validity.'*

Focusing on validity, the text below emphasizes this statement in order to show the background for the logic that is going to link the different data that will be collected in this thesis.

It is important to ensure ***external validity*** when designing the research in order to show how accurately the study represents the problem studied. Establishing generalizability in the result is vital here and repeating case studies to verify patterns is a way of ensuring this. In the case of this thesis, one tries do this through presenting the interview questions to several of the company's departments and to make questions that are of a refining and validating nature (Stuart et al. 2002). The people who have been interviewed represent different departments and business areas and are on different management levels (see appendix 15.2).

Establishing good measures for the problem that is being studied makes this issue part of data collection. There are three elements connected to establishing ***construct validity*** as stated and discussed below:

1. Multiple data sources
2. Establish and maintain a chain of evidence
3. Draft review by key informants

Finding multiple data sources to avoid errors due to subject bias can be achieved by for instance having several interview objects, using direct observation and having access to underlying company procedures. This method of triangulating the research input can help corroborate the data to avoid bias becoming a source of good construct validity.

Establishing and maintaining a chain of evidence is important to ensure the reader is able to understand and follow the case data throughout the text. This should be done by external reviewers, with focus on logic, flow, clarity and content. This should reveal if there is logic to the flow of text and a coherent chain of evidence.

Draft review by key informants, is done by key personnel in the studied organization, who are given the opportunity to review the result of the study. A review can reveal important information that may lead to changes to individual cases should the care report contain inaccuracies or errors.

In the case of the interviews and also the following informal talks, the review was done concurrently and at the same day as the interview was done. The author would go through the questions, the interviewee's answers and notes from the talks, to ensure that there were no misunderstandings.

Internal validity is a concern in explanatory case studies and this thesis has a side to it that involves attempting to find solutions to some problems described later. (Ellram 1996) quotes Zysanski et al., Crabtree et al. and Cozby et al. in stating that: '*Internal validity in case study* *research relates to making proper inferences from the data, considering alternative explanations, use of convergent data, and related tactics.'*

This thesis gives several suggestions to current organizational problems by making inferences to the collected data and by looking into convergent data from the different departments.

Given these prerequisites, it seems that finding new solutions to the problems described earlier, both ***the exploratory research method*** and ***the explanatory research method*** are applicable. The explanatory approach will provide data for suggestions to solutions and the exploratory approach should give a good foundation for further research work into the topics that are discussed in this thesis.

(Ellram 1996) also defines four classes of research methods; exploration, explanation, description and prediction. In order to serve the applied methodologies within exploration (qualitative and quantitative), some of the questions she establishes are of the 'how' what and 'why' nature - this to acquire more depth of information and insight into the case being studied.

Interview technique is an important factor and at least two forms seem relevant here (Ellram 1996); the unstructured interview which has an informal approach and is conversational in nature, the semi structured interview for finding critical incidents.

7.2 Methodology

This research will be based on several logistical and organizational theories in combination with the authors' 20 years of experience working for the company and in this industry.

Interviewees will be presented with a set of relevant questions to help the information gathering process. This is done to reveal any possibilities and limitations to existing software systems and current user routines in the organization. The questions will be given as part of an unstructured interview, and in line with the informal talk, making them more of a general guideline to keep the different conversations on the same track.

The different departments will be exposed to the same questions and treated as if they are standalone cases. There will not be any opacity here however, as one is open to finding similarities between departments that may create synergies. This is interesting as it could help the company become more efficient in its daily routines.

The author's work in performing daily assigned activities will be part of the information gathering as well in order to gain some observational data in the process. Also, there will be some collection of internal documents and / or archive data as needed.

The result of the study should provide a basis for development of a new solutions platform for information management.

Observing team leaders and operatives in the field to obtain first hand operational data is another approach that will be used if necessary. The most prominent IT systems within the company shall be scrutinized to see if there is a possibility of using one or more of these systems in a future data sharing system.

A mapping of the work processes involved will be carried out to find information gathering activities that can be covered by using proprietary IT tools. The idea is to find and remove tasks that involve non-value added work to provide a clear set of value adding tasks that can be implemented as routine in any new software based data collection tool.

7.3 Project management

Information sharing and communication with the supervisor is conducted as needed and on request, via email, internet phone / video (Skype) and possibly sharing of documents via Google docs or Microsoft SkyDrive, depending on preferences or what seems most pertinent to the participants at any given time.

The author is well aware of the possibility of having a certain degree of bias, and will seek advice in revealing any problems related to this, such as leading questions during interviews or blindness to any "Elephants in the room" (Wikipedia 2012).

7.4 Interview questions

Some of the questions used are designed as 'Grand tour questions' giving the respondent a chance to elaborate on topics that are well known to them. These questions are well suited for semi structured interviewing and should provide more surrounding information and give an impression of what an average day is like for the subjects (Leech 2002). Most of the other questions are of the 'How' and 'Why nature.

7.5 Strengths and weaknesses of interviews

The following is an excerpt of a list of strengths and weaknesses of interviews in this setting according to (Alabama 2014):

Strengths of interviews

- Good for measuring attitudes and most other content of interest
- Can provide in-depth information
- Can provide information about participants' internal meanings and ways of thinking
- Telephone and e-mail interviews provide very quick turnaround
- Moderately high measurement validity (i.e., high reliability and validity) for well constructed and tested interview protocols
- Useful for exploration as well as confirmation

These points serve to strengthen the case and are considered both in the making of the questions used, and during the informal interview process.

Weaknesses of interviews

- Reactive effects (e.g., interviewees may try to show only what is socially desirable).
- Investigator effects may occur (e.g., untrained interviewers may distort data because of personal biases and poor interviewing skills)
- Interviewees may not recall important information and may lack self-awareness
- Measures need validation

The author's intimate knowledge of the company, served as a tool when it came to selecting interview subjects and getting people who were known for their honesty and straightforward nature in person to person communication. This was done to lessen any possible reactive effects. The interviews were all performed by the author and he made use of the information available to him to make up for any poor interview skills, and made sure to try and have an open mind going into the interview situations.

Whenever any interviewee was not able to recollect information the author either gave the subject the opportunity to come back to the answer at a later time. If the person was not being able to see his or her own personal bias or trailed off during the interview, the author would always try to put him or her back on track by using prompts as suggested by (Leech 2002).

8 Current operational solutions

In this part, the current way of handling standard operational work orders is described.

8.1 Information management

In the author's view, the principles of information management as they are described in chapter 9.2 are met to a varying degree through Vestbase's daily activities and fit well into the idea of the need for improving information management to increase supply chain performance. The key factor here would be to improve and increase the effort on these points and have the organization work in a more similar way across departments.

8.1.1 Information management and invoicing

One issue that is causing a relatively large amount of non-value added work is errors in invoices sent to Vestbase's customers. This causes a lot of communication back and forth to find the true data that is supposed to make out the body of these invoices, both internally within Vestbase and towards its customers. The data collected for invoicing customers is today manually entered into the existing IT tool at Vestbase's customer center (RMC Basic) and the basis for this data is founded on the work performed by the different work teams.

As mentioned, communication relies heavily on VHF radio and mobile phone for exchanging information between the work teams and the customer center (see Figure 13). This form of communication often leads to misunderstandings and misinterpretations, as well as information not getting through / not being picked up by the coordinators and thereby not invoiced. This is generally thought to be one of the most important reasons for many of the errors that occur in invoicing.

8.1.2 Information management at the customer center

The amount of information that flows through the customer center is large and often much more than the coordinators can handle in a qualitative good way. The challenge is that much of the data is registered sometime after it occurred which leads to errors and delays in invoicing or that the data is never registered at all. This seems to be valid both for the internal data flow in Vestbase as well as between Vestbase and other companies. Utilizing such data for increased information availability is a key factor in this text.

Not only radio communication, but also telephone, email and verbal communication, is putting stress on the coordinators, increasing the probability of making errors during the registration of invoicing information. No internet chatting software (Skype, Google hangouts, MSN etc.) is in use and there is relatively little use of text messaging.

A simple check of time consumption at the customer center was done, (figures shown in Table 2), and the numbers indicate that the cost of said communication forms is high. Summing up over the course of a year (07:00 – 20:00 / 250 work days a year, at NOK 600 per hour makes NOK 3.220.000,-) there seems to be a good potential for improvement here (number of coordinators include the approximated combined efforts of other departments – a total of 8 - average number of coordinators at customer center is 5 - incoming and outgoing occurrences are per coordinator per day).

Total cost was found by multiplying the number of minutes spent by each person with eight and from there figuring out the number of hours and thereby total cost.

Activity	Incoming	Outgoing	Duration (sec.)	8 coordinators	sum minutes per year	sum hours per year	sum cost per year
Telephone	16	18	41	328	82000	1367	820 000
Email	134	5	45	360	90000	1500	900 000
Oral	15	-	60	480	120000	2000	1 200 000
VHF radio	45	45	15	120	30000	500	300 000
Fax	-	-	-	-	-	-	-
Notes/paper	-	-	-	-	-	-	-
						Sum per year	3 220 000

Table 2 Cost of misc. forms of communication

The estimate is somewhat low due to the fact that only ordinary workdays have been considered – Vestbase operates 365 days a year, and even though there are fewer people at work the remaining work days, the communication cost is most likely higher than seen in the table. In addition, only hourly rental cost for the coordinators has been included (the alternative cost for selling their services to a customer). Costs like calling costs, time spent by others in the communication process, and other factors, have not been considered.

In addition to registering a large amount of invoicing information, the coordinators have to make many and frequent decisions on the different work tasks during the day. This increases stress levels and load on the coordinators' cognitive skills. Since these forms of communication are rather poor and often lead to misunderstandings, it is generally thought to be one of the most important reasons for the many misunderstandings and poor data quality

Decision making on work tasks is one of the main functions of the customer center, so any change that will reduce time spent on non-related and/or non-value added types of work (e.g. managing invoicing data or communicating via phone, email and / or radio) will free up time for the coordinators. This should provide better working conditions to perform more value adding work at the customer center.

Table 2 shows a way of managing information that may have room for improvement. Good information management usually comprises a much wider scope and analogue data or electronic data in simple form, like emails is not well suited for sharing and / or distribution, seen in the light of Best's definition of the term (Best 2010). The definition by Best in chapter 6.1 is revealing in that it calls for an '*economic, efficient and effective'* way of handling information. It is not hard to envision the same analogy to the collection of the underlying data, which the customer center is engaged in at Vestbase.

8.1.3 Information management in the local supply chain

Operators in the field usually get orders from the coordinators on what they should do, and they don't have any power to contribute to the decision making process.
Empowering the operators by allowing them to take part in some sides of the data registering and decision making process seems interesting, and moving, or decentralizing some of the tasks performed by the coordinators to the work teams and their operators, could prove effective in increasing the quality of the data.

8.2 Current systems information

As mentioned, Vestbase has many different database systems to fulfil its needs. The following is a shortlist of the ones most relevant to the company's information management needs:

8.3 Internal information management systems

- RMC Basic
  This is Vestbase's main system for coordinating base area activities, from transport missions to lifting operations, loading and unloading of supply ships etc.
- Corporater
  This system generates scorecards, performance dashboards, helps with benchmarking and other services
- Automate
  The program is used for extracting data from one or several databases to enter this information into i.e. spreadsheets for custom reports, task reminders and many other types of automated tasks
- Excel spreadsheets
  Used for a variety of data collection tasks

8.4 External information management systems

- RMC net
  Basically the web portal for customer entry of work orders into RMC Basic
- KAIA
  A pier allocation system currently in development

8.5 Incoming work orders

Work orders are issued by the customer through an internet portal (RMC Net) where all customers and their respective users are issued user names and passwords by Vestbase (Figure 11). When the order is sent, it can be viewed by anyone with access to the internal order handling system (RMC Basic) for instance the customer center.

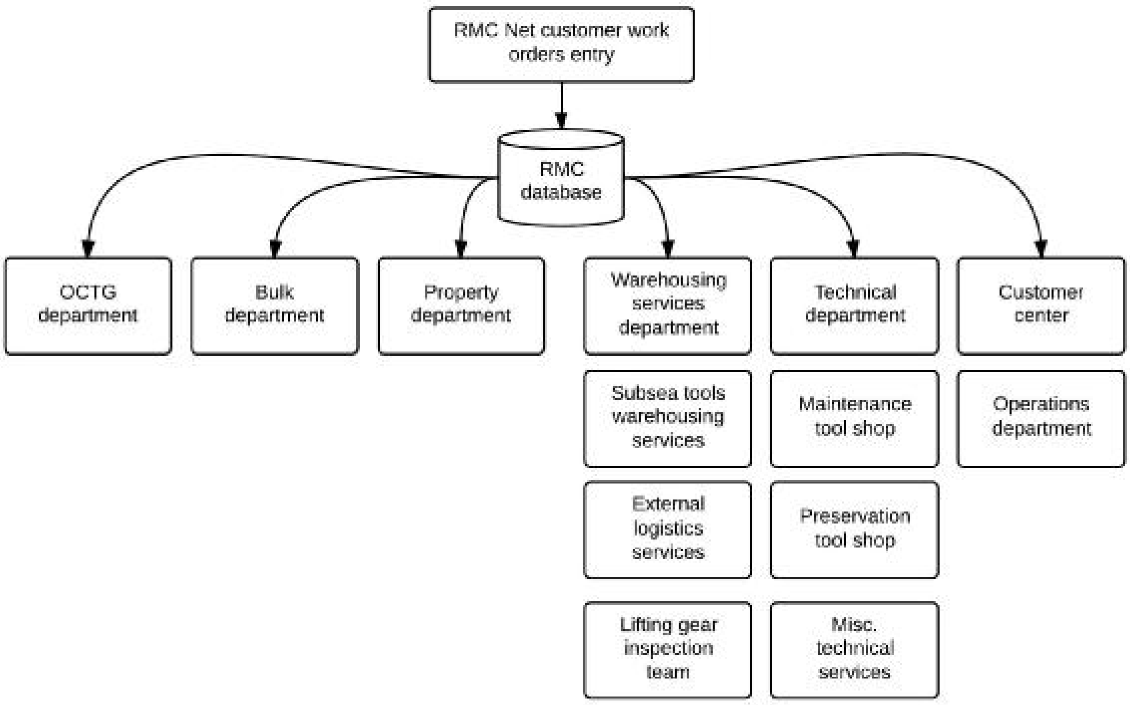

Figure 10 RMC incoming order organizational chart

One of the main points of this system is that the customer can direct the orders to the department that will be performing the work task, so if it has to do with bulk cargo, the order is sent to the bulk department, pipe services to the OCTG department etc. (see Figure 10). Should the order be sent to the wrong department, it is possible for Vestbase's coordinators to change department internally.

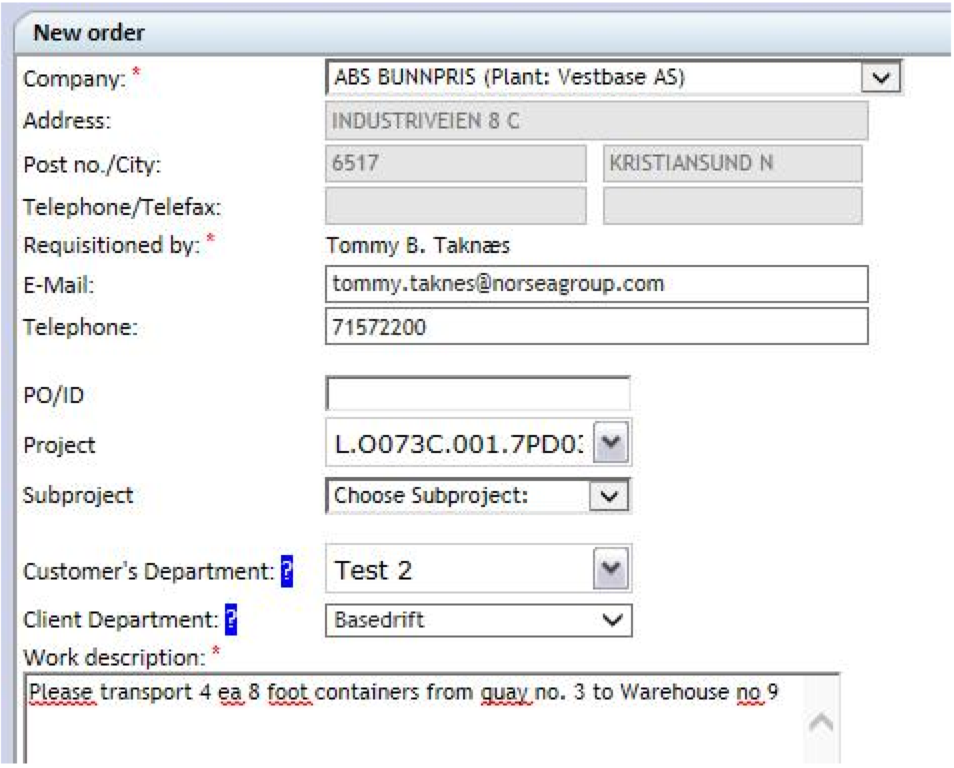

Figure 11 Customer work order example (source: Vestbase AS)

The portal also has search windows and history lookup and the current state of a work order is continuously communicated through the portal as well, so in a way, information is managed to a certain extent already.

8.6 Communicating work orders to the operators

When the work order is received internally (Figure 12), planning can begin to effectuate the order. Usually a coordinator at the customer center (or a team leader at any other department) starts to find a solution by evaluating which resources that is at his disposal. When the planning is complete, the order is given to relevant personnel, either a foreman or directly to the person who will be doing the job (i.e. a forklift operator or roughneck). As already explained, this communication is usually done by using media that gives low quality information (i.e. VHF radio and telephone) and at the same time these channels always require the respondent to answer there and then, meaning it can take time to get hold of the person in question to settle the work task. This is inefficient and often leads to misunderstandings and more non-value added work.

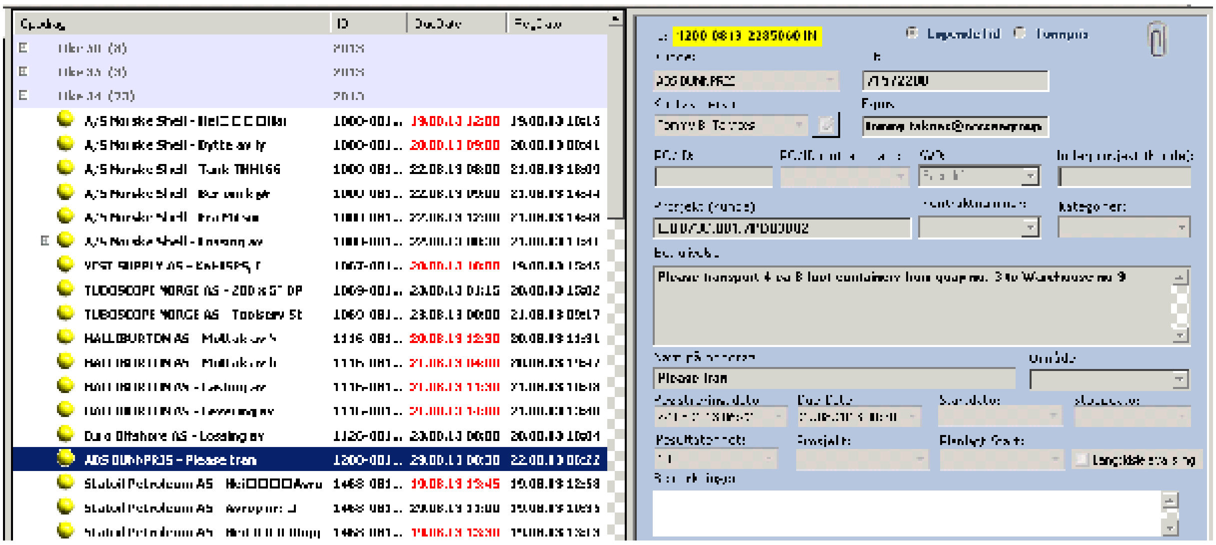

Figure 12 Customer work order as seen in Vestbase's incoming work task list (source: Vestbase AS)

Figure 13 shows how most of the communication is performed today. Orders are given by VHF radio or mobile phone to the teams in the field.

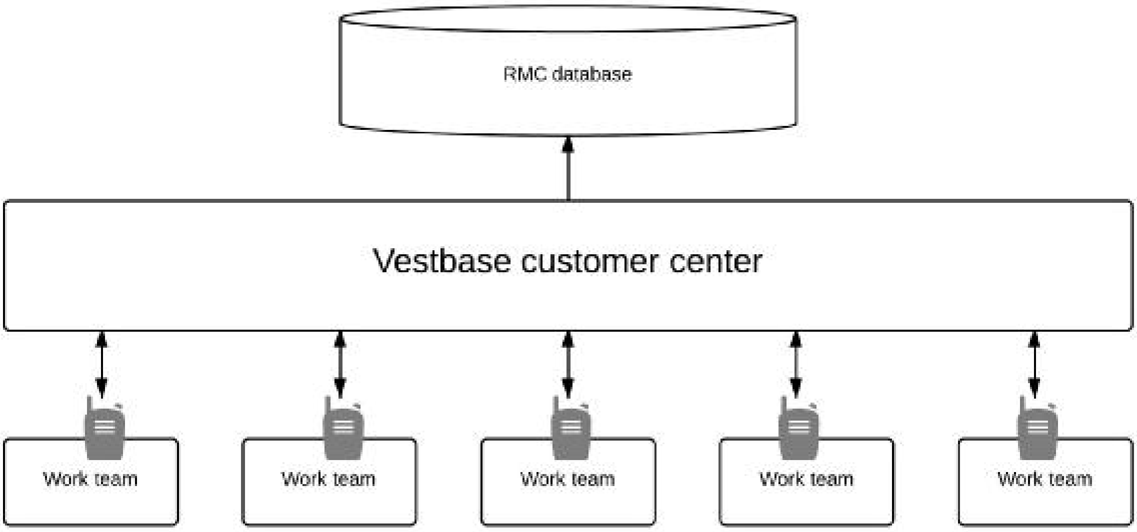

Figure 13 Current communication routines

In order to make this process more efficient, the company has commissioned a smart phone app that is able to receive orders forwarded from RMC Basic. This enables any operator that is logged on to see available transport missions (currently only very simple transport missions).

The app is very simple and can so far mostly handle only missions that call for forklift operators and the use of forklifts, but has already changed operators' work day a lot and is bringing several positive elements into the picture. The user feedback so far has included:

- Less radio clutter and noise
- More autonomy
- Less authority interference
- A more interesting work day

The operators feel that their work situation is more comfortable, with less noise and disturbances. Also, people feel more satisfied with their work day in general and that they can contribute to save time by picking jobs that are in their vicinity, instead of having to drive long runs to pick up cargo. Obviously this is valuable both for the company as well as for the supply chain, as time saved in this way means higher efficiency and less non-value added work.

An interesting element here would be to see if this app can be expanded to include more complex work tasks, to see if it is possible to recreate the same positive effect on a larger scale. (See example in Figure 14).

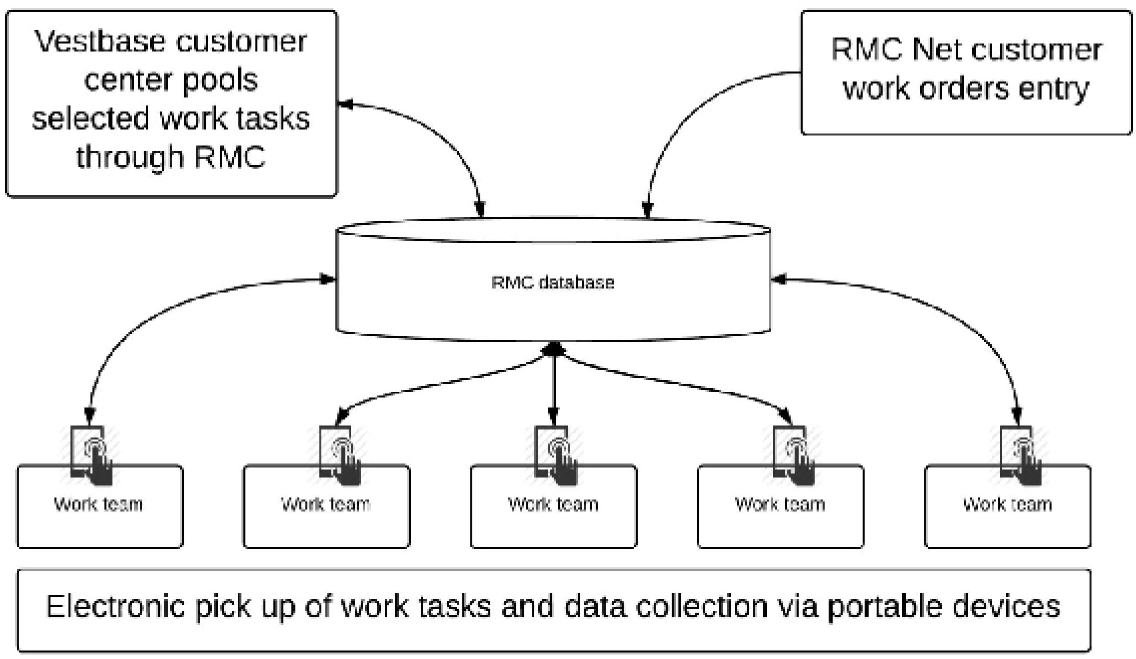

Figure 14 Possible future communication routines

8.6.1 Loading and unloading supply ships

It is worth mentioning the loading and unloading of supply ships, as this is an important area of income for Vestbase and one of the biggest focal points of activity at the supply base. The reasons are that several of the largest contracts the company have, are payable by how many tons of cargo is loaded / unloaded to and from the supply ships. The work Vestbase does for the customer under these 'Ton price contracts' includes receipt, warehousing, handling, packaging and loading and unloading of goods, as well as other services.

This means that efficiency is paramount to achieve a good overhead, since the price doesn't vary with how much time is used on the work, but with the total mass of goods that is loaded onto the ships. The second reason for the importance of supply ships is that they are the vessels that carry cargo to the offshore rigs.

The rigs are the end customers here and the main reason for Vestbase's activities so it is important that the link between Vestbase and its local end customers (the supply ships) is not made into a bottleneck for getting cargo offshore. Increased efficiency in loading the supply ships means less time by the quay and more time offshore, increasing the value received by the rigs.

8.6.2 A note on HSEQ and cargo weight

Cargo trucks and supply ships cannot receive cargo without information on the cargo's weight due to limits to truck loading capacity and ship stability. HSEQ is a very important topic in the industry and should not be overlooked as one may have delays through mishaps or accidents due to wrong weight information.

If an accident should occur, there will usually be a delay, and if a ripple effect causes a supply ship to have a delayed departure, offshore rigs may suffer for it through stop in drilling and / or production.

There are very large costs involved in offshore drilling and production operations, and having cargo arriving late can cause stop in these activities and leading to relatively large losses in revenue (both in lost drilling time and lost production time). As an example one may consider a production platform that has a production 100.000 barrels of oil per day; at the time of writing, the Brent crude spot price is about USD 110 (Offshore.no 2013), putting daily losses during a shutdown to about USD 11,000,000.

This is obviously a substantial number, especially considering how easy it is to reduce the risk of such losses just by conforming to HSEQ standards. The example is extreme to be sure, but in daily operations, these kinds of situations occur almost every day. Albeit on a smaller scale, but nonetheless it is a problem that should be treated and eliminated if possible, as cost on these smaller and perhaps more local incidents can accumulate and contribute to increased cost locally.

An interesting idea here would be so see if the LogisticsHub database can be used to communicate cargo weights, in order to increase HSEQ and perhaps also rationalize the registering of weights at the supply bases.

8.7 Integrating the oil and gas supply chain

The oil and gas industry has had many logistical difficulties over the years, and there have been relatively few industry wide improvement projects attempting to change the situation. One improvement effort that is starting up now however, is EPIM's 'LogisticsHub' project (EPIM 2013).

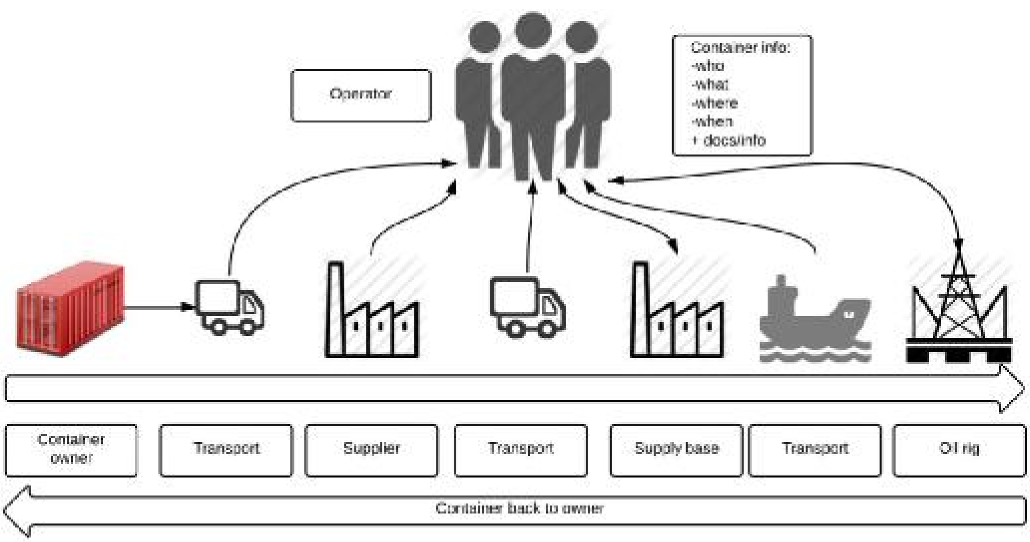

Figure 15 Container routing

This is an effort to gain more control over the flow of all containers through automated tracking of CCU's (Cargo Carrying Units) firstly by using active RFID (Radio Frequency IDentificaton) transmitters on each container, and on a wider time frame (phase 2), the contents of each container (Figure 15). The information in this system will be available to any actor who is willing to participate, giving these participants the possibility to take part in the supply chain in a new and more collaborative and informative way.

One key factor in this project is that any actor in the industry can take part and contribute to the system. By entering its own operational data (container names, contents etc.) into the system, any actor with relevant access can view the containers' location, destination and other relevant information.

As a supply base owner, Vestbase has *'access to all events generated by CCUs in her/his custody and events of the CCU on the way to her/his custody loading and departing previous site'(gass 2012)* (this is somewhat dependent on which rights Vestbase is given by the individual container company and oil company).

8.7.1 Information Governance

Information governance (IG) is defined as: *'The specification of decision rights and an accountability framework to encourage desirable behavior in the valuation, creation, storage, use, archival and deletion of information. It includes the processes, roles, standards and metrics that ensure the effective and efficient use of information in enabling an organization to achieve its goals.'* (Gartner 2013)

The LogisticsHub governor would be handling the information in this industry wide supply chain information hub Figure 16. This is fitting as the role requires the actor to be neutral, and to incite accountability and the right behavior among the participants.

As should be clear, the role played by LogisticsHub has to be a neutral one, as information from so many supply chain actors is handled in one place and many of the actors may consider their information both confidential and key to their competitive strengths.

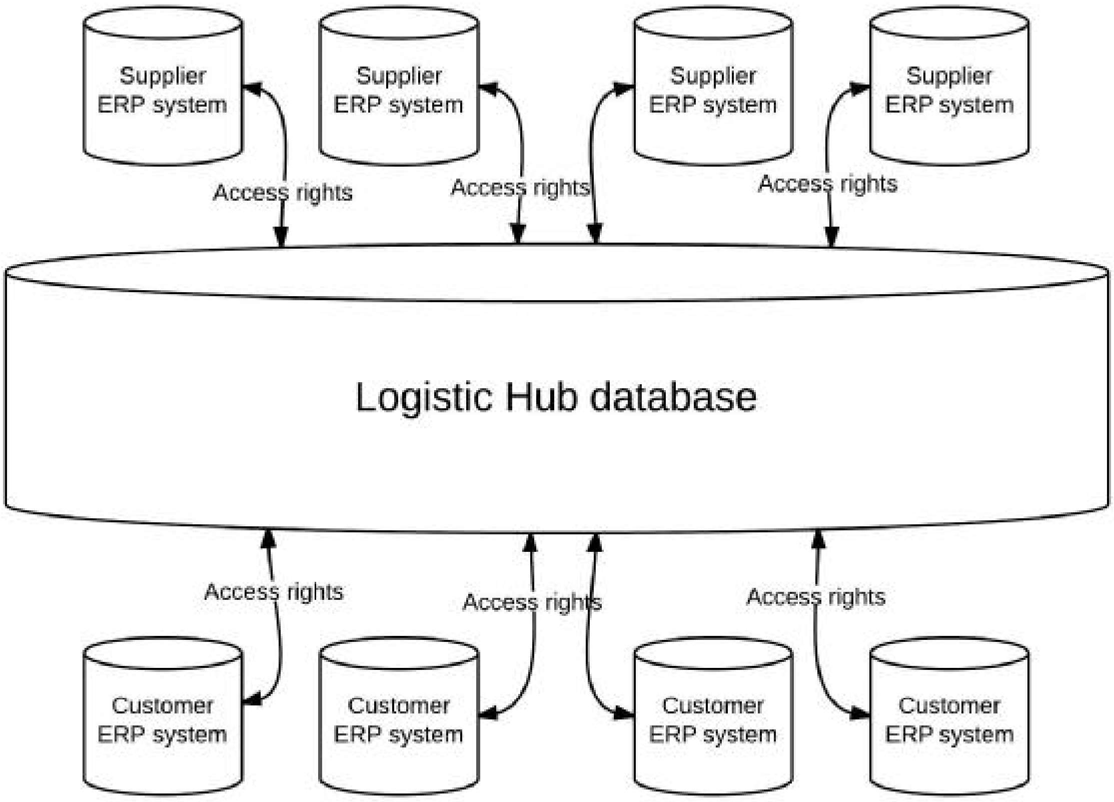

Figure 16 LogisticsHub governance relationship

An example here is the container suppliers who may put data into the system that can be read and used by competitors. If there is not a governing system for the protection of company data, it will be difficult for users to trust the system. A system of access right seems pertinent and may have to be considered by the development team at Vestbase.

8.7.2 LogisticsHub setup

The LogisticsHub system will be based on having an intermediary database setup by a third party solutions provider. The database will relay relevant positional data to participants with access to the system. Any participant can gain access to this data on a need to know basis and may also develop interfaces (the graphical screen views used to interact with the database) between its own systems and the LogisticsHub database.

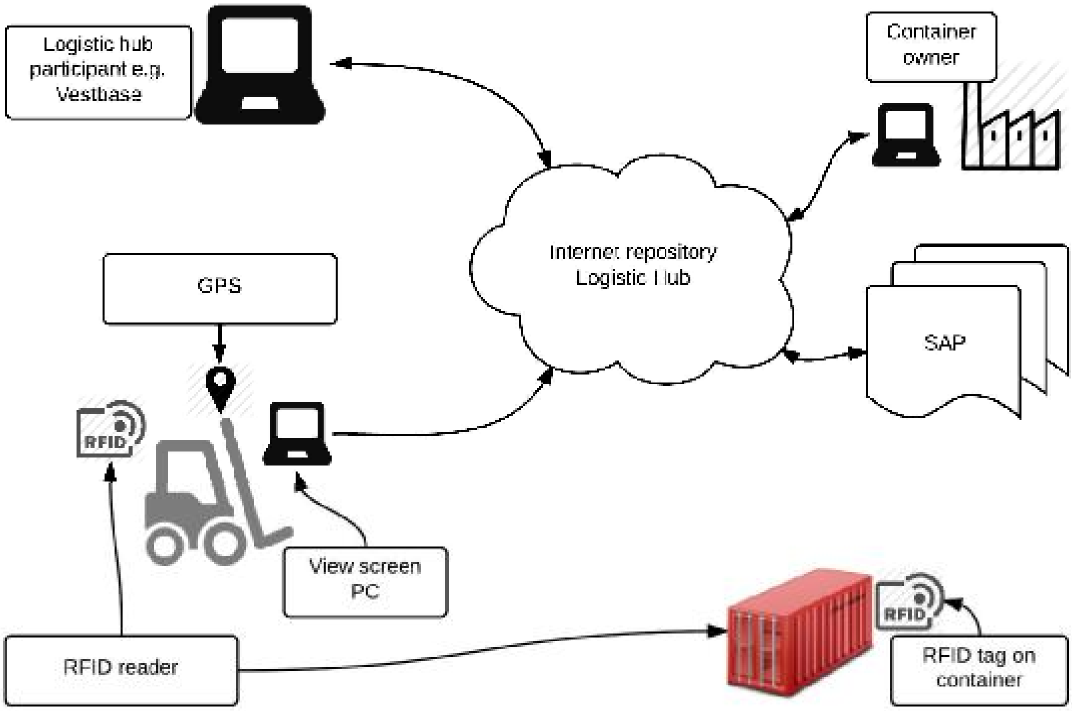

Figure 17 LogisticsHub physical setup

It would be interesting to see if Vestbase can utilize this in a beneficial way. The company has already been asked by the LogisticsHub project leader (source: Vestbase AS)to install adapted hardware in forklifts and cranes to enable automatic reading of container data and it is in the nature of this project that Vestbase can participate as closely as it wants to. This package includes computer tablets with mobile phone 3G communication technology for managing the RFID data. This system could provide a way of communicating other relevant data as well.

As can be seen in Figure 17, the system will be set up to share container information so that anyone with access (e.g. vendors delivering goods or supply base operators) can contribute with information. This provides several opportunities, given that a participant can be allowed access to write information to the database as needed.

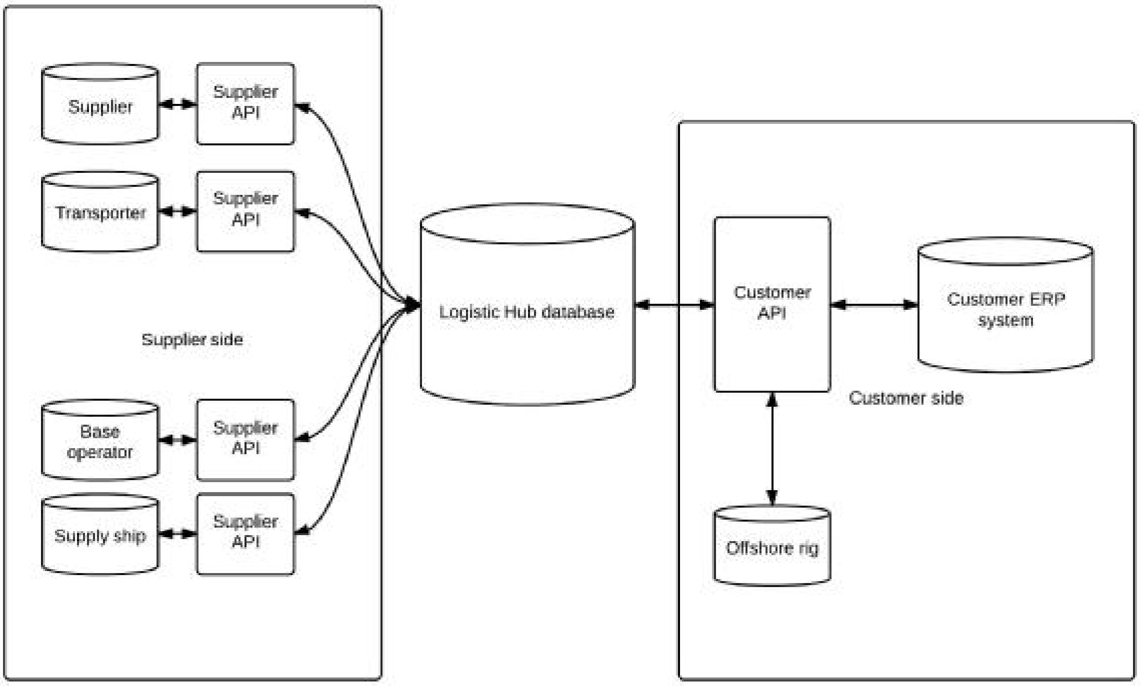

Figure 18 Information management in LogisticsHub

In a more simplified form, Figure 18 shows how the information flow may look to any willing LogisticsHub participant. The flow of information goes toward the end customer which usually is the offshore rig, or, in some cases, the onshore representative of the rig.

Information entered into the database can be viewed by for instance the end customer, the supplier or even the transporter, for an updated look at the cargo. This includes information on location of the cargo, which is the one of the main goals of the LogisticsHub project.

8.8 Application of theory

Since the main focus of the thesis will be to describe a tentative and heuristic solution to the aforementioned challenges faced by the company, the goal here is to use applicable theory to support the findings made in the work. Furthermore, it is vital to the end result that pragmatism is in focus as much as possible, as the work environment at Vestbase is of a practical nature.

8.9 Information management among operators

As previously mentioned, effort has been made in order to empower the operators in the field to be able to take part in the registering of data and management of the resulting information. There are both active and passive solutions on this, relating to the degree of interaction necessary by the operator.

8.10 Active solutions

The most current active solution is an Android application (app) that has been developed to let forklift operators get information on transport missions (referred to as a taxi job) on a tablet that they can bring with them in the forklift. Shown in Figure 19, this app (Called RMC forklift) shows job information relayed from RMC and lets the driver choose transport missions suitable to his position, knowledge and vehicle capabilities.

Empowering the operators like this, enables the coordinators at the customer center to distribute these types of jobs to the drivers in a more efficient way, and increases available time for other tasks they have to perform at the customer center.

As mentioned, the app has also brought other benefits, like reduced noise and disturbances due to radio traffic, and increased utilization of operators by a new and more collaborative way of working (drivers coordinate activities between themselves instead of going via the customer center). This has been observed in the way the drivers work together on a transport mission that may require more than one forklift for it to be executed efficiently.

The app also enables the operators to choose jobs that are in their vicinity, reducing driving time between jobs and contributing to lowering operational costs and greening of the supply chain.

Figure 19 RMC Forklift application interface (source: Vestbase AS)

Another active solution involves mobile phones as the foremen who lead most of the ongoing outdoor jobs are, in addition to VHF radios, equipped with smart phones, and these have proven a valuable tool in several ways.

In addition to normal phone and email functionality, the embedded internet browser is being used to fill inn web based forms that relay information about certain rental equipment that is used on many of the outdoor jobs. These forms include MAFI truck trolleys, pipe loading rams and lifting straps (Figure 20).

One passive solution is that every vehicle above a certain size has been fitted with a GPS device that reports the vehicles’ position to a server. This data informs the coordinators at the customer center where the vehicle is located (on a map of the area) enabling them to allocate vehicles that are close to where the work is going to be performed (Figure 21).

Figure 20 MAFI truck carrying pipe rams in lifting straps (source: Vestbase AS)

8.11 Passive solutions

Another feature here is that the icons that represent the vehicles on the map change color according to what state they have in RMC Basic (Green = available, red = unavailable).

Figure 21 Vehicle position and availability (source: Vestbase AS)

This ensues another passive solution, that whenever a forklift driver starts a taxi job, his forklift is automatically set as unavailable in the system and its corresponding icon in the Google Earth map turns red, and it is set back to green again when the driver ends the job.

9 Description of theory

Central theoretical elements for the thesis are decentralization, coordination, decisions under uncertainty and information management.

Utilization of new technology is another method for improvement that should be looked into. The internet and smart phone technology has penetrated society and many people own smart phones that have the potential of both enriching and improving people's lives.

"*There's an app for that*" is an expression that has been trademarked by the media company Apple. The number of Smartphone applications or apps is very large – in the millions - showing the impact of this technology (Slivka 2010). It would be of interest to see if Vestbase could benefit from using this approach to support the improvement of information collection and data quality.

Creating an optimal mix of decentralized and centralized attributes in the system could be of great importance to the company and key to a successful organizational change towards this goal. Consulting with the company's IT department seems essential, in order to establish whether such a project would be feasible within the constraints of the current IT system and hardware infrastructure of the company.

9.1 Literature review

This chapter describes literature considered to be relevant to the main research problem.

9.2 Information management

In addition to the definition of Information management in chapter 6.1, (Best 2010) the following text adds to the scope:

'Information management is the management of organizational processes and systems that acquire, create, organize, distribute, and use information' (Toronto 2013)

According to this definition, information management consists of six related activities:

- *Identification of information needs*
- *Acquisition and creation of information*
- *Analysis and interpretation of information*
- *Organization and storage of information*
- *Information access and dissemination*
- *Information use*

An organization that manages its human resources or other assets like properties or financial assets, should also treat information in the same way. The same basic functions for managing organizations activities apply to information management as well.

The theory gives the following benefits for information management:

- reduce costs
- reduce uncertainty or risks
- add value to existing products or services
- create new value through new information-based products or services

9.3 Centralized and decentralized organizations

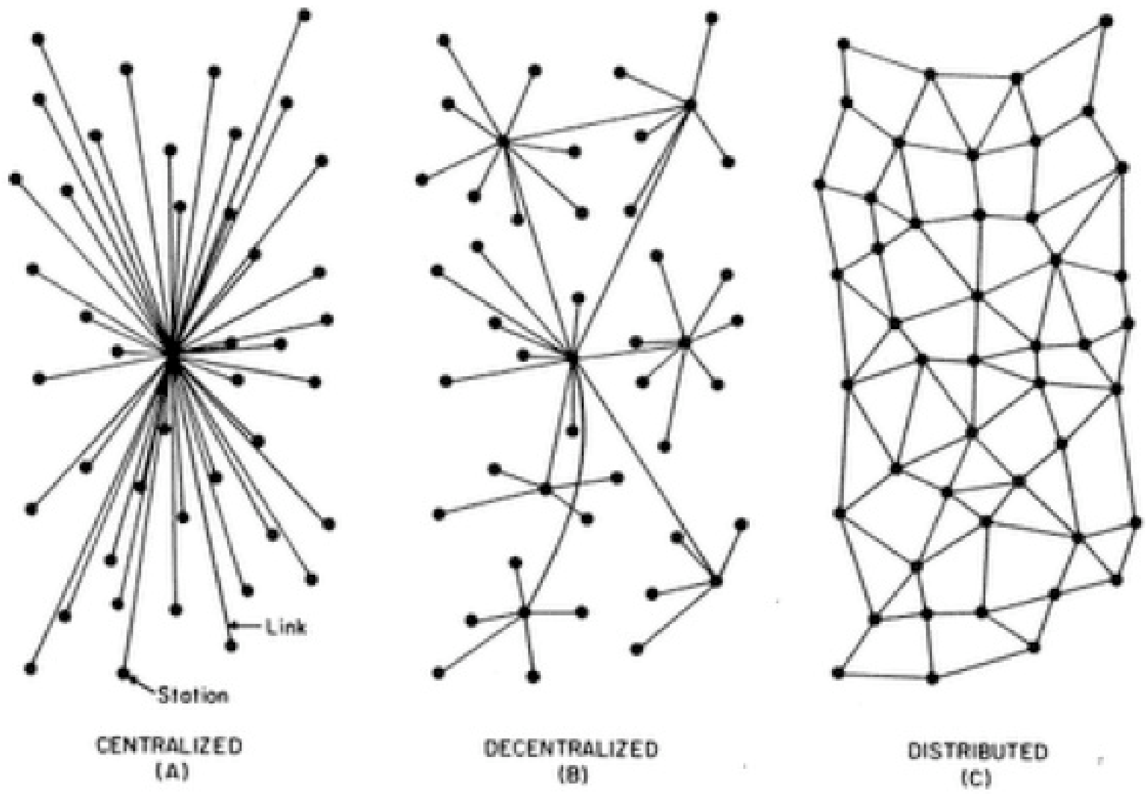

Figure 22 Centralized and decentralized organizations

Figure 22 shows possible centralization setups of an organization. Models A and B would be interesting for the purpose of this thesis. There is a single hub in the centralized organization (A) and if this section is not working, the whole organization is left useless and all the links in the system will fail to fulfill their purpose. The decentralized organization (B) has several hubs and is less vulnerable to a single hub breakdown and would provide a more robust setup for gathering of information (Ori Brafman & Beckstrom 2006).

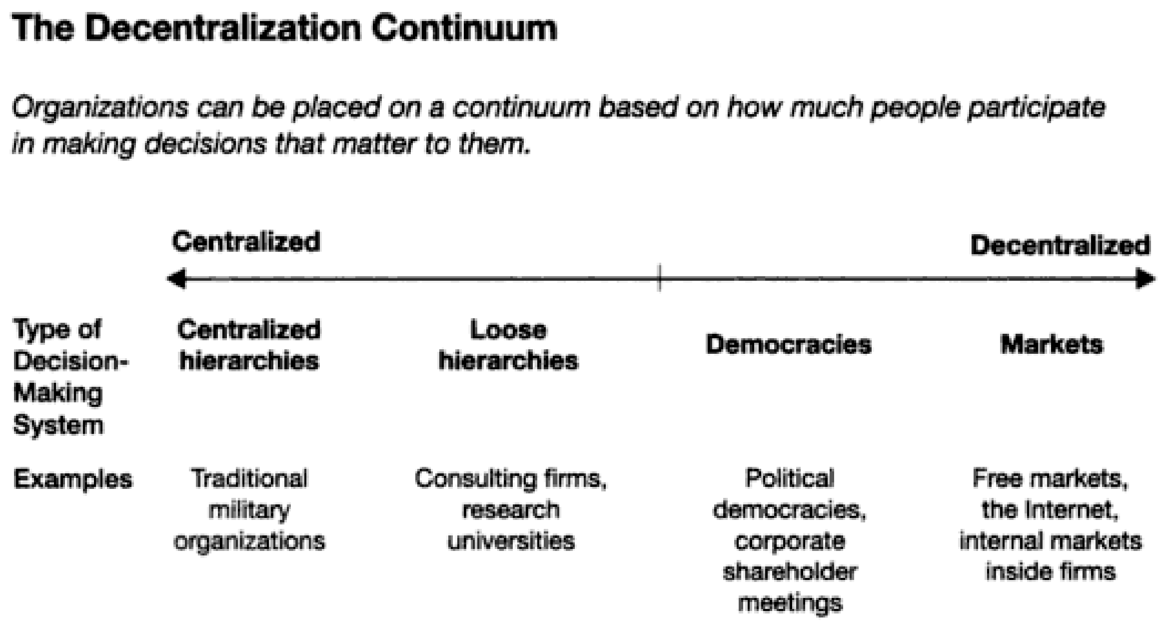

Figure 23 Decentralization continuum

The degree of freedom people have in decision making, increases in a more decentralized organization (Figure 23). Moving operational decision making further down in the hierarchy by empowering the operators, who are actually adding value to the end customer, will be a key aspect in this thesis (Malone 1990).

9.4 Supply chain practice and information sharing

'Effective supply chain practice and information sharing enhances the current supply chain management environment' (Zhou 2007).

(Zhou 2007) shows that by sharing information effectively and having a good supply chain practice, one can improve overall supply chain performance. They also state that these two approaches are not independent of each other and should, if possible be implemented together, in order to achieve maximum effectiveness from the effort.

The oil and gas industry has undertaken a large program commonly known as 'integrated operations'. There are several definitions of the program and one of the better ones is described such:

"Integrated Operations (IO) is integration of people, work processes and information technology to make smarter decisions and better job execution. It is enabled by global access to real time data, collaborative technology and multiple expertise – across disciplines,

organizations and geographical locations.' (Center 2011). With this in mind, there is a clear incentive for Vestbase to join this project and a closer knowledge to it seems important.

9.4.1 Supply chain practice

The paper looks at two types of supply chain practices, which both are related to delivery performance;

- Supply chain planning
- Delivery practice

Supply chain planning activities processes information from suppliers, customers and internal operations, to fulfill two goals; making forecasts and coordinating activities across companies. Inter-functional coordination within a company is covered and is interesting to this thesis as this is one of the variables that the focus company is dealing with, and there is research that shows that this kind of cooperation can be valuable (Lee and Whang 2000).

Delivery practice (in the sense of 'how we do things') has importance as well, since Vestbase delivers many different types of services and in many different ways. Improving delivery practice can give competitive advantages. The focus paper here, gives grounds for the development, validating and testing processes for such a move.

9.4.2 Information sharing

Information sharing is divided into three aspects (Zhou 2007);

- Information sharing support technology
    - Hardware and software that supports information sharing
- Information content
    - Information shared between producers and customers
- Information quality
    - A measurement of the quality of the information shared

9.4.2.1 Information quality

This measure tells whether the information shared fulfils the different participants' need for information. The paper refers to several different aspects of quality (Zhou 2007);

- Accuracy
- Availability
- Timeliness
- Internal connectivity
- External connectivity
- Completeness
- Relevance
- Accessibility
- Frequently updated information

These factors play an important role and should be taken into consideration when managing information.

9.4.2.2 Information content

Two types of information flows are discussed and these are: the information that manufacturers share with their customers and the information that customers share with their manufacturers. This is interesting to this thesis as well, as RMC is becoming a sort of communications platform in some ways, both when it comes to customers' information shared with Vestbase in work orders, and for information that Vestbase wants to share with its customers in the form of startup times, delays, work order status, invoicing information etc.

9.4.3 Information sharing support technology

This thesis focuses on the new development of advanced supply chain IT applications that are categorized by their individual planning periods: short term, medium to long term and one category for supply chain execution management which supports and connects the two first applications.

Considering how easy it is to be connected to the internet today, this seems quite relevant as it should enable the distributed use of hardware tools in a more widespread way. The right set of hardware tools would help support the use of IT applications for data collection and work task allocation, thereby helping supply chain execution management.

9.4.3.1 Supply chain dynamism

The definition is *'the unpredictable changes in products, technologies, and demand for products in the market' (Zhou 2007).* Zhou's paper *'Supply chain practice and information* *sharing'* coins the term 'Clockspeed', naming three different speeds: product clockspeed, process clockspeed, and organization clockspeed. These clock speeds *'measure the pace of the changes in business environment and are shown to have a significant impact on operations'*. In this context, the term is a measure of how dynamic the industry is when it comes to changes in the supply chain management and how its rate of evolvement is.

Another support for this is found in an essay by (Fine 1996) which states that *'The clockspeed framework suggests a dynamic theory of the firm where the "inner core" competency of an organization is the ability to continually design and assemble of chains of competencies to deliver value to the marketplace'*.

So it would be interesting to see if having a more distributed use of IT applications for data collection and work task allocation can improve how the organization copes with the pace of change in the local, and perhaps even the overall supply chain.

9.4.3.2 Delivery performance

This performance criterion can be used in several ways. For the purpose of this text, on-time delivery and perfect order fulfillment rate are used as criterions.

Figure 24 gives an impression of how supply chain practice and information sharing are interdependent on all above mentioned factors and it is clear that supply chain dynamism is represented by the LogisticsHub project in this text.

Following this practice in the implementation of the project could prove to be beneficial. Since Vestbase is committed to deliver within an hour of order reception, measuring performance is a factor and more accurate data through collecting in the way described in chapter 9.3 could pave the way for more accurately measuring the time spent between an order arrives and when it is started.

This can be achieved if the operators can start the jobs electronically having the right hardware / software tools at their disposal, instead of having to use VHF radio to inform the customer center of start and stop times.

Figure 24 Supply chain practice and information sharing

9.5 Importance of mobile solutions

Smart phones empower people to a new extent when it comes to implementing sustainable information systems (Leyland F Pitt 2011). Smart phone applications are abundant and easily obtained through technological intermediary services.

Middleware is one of these technologies that such intermediaries can provide, and is of interest to this thesis as it would make up an important component of a potential new software solution (Pereira 2009).

9.6 Coordination theory

Thomas W. Malone has defined coordination as: *“The act of managing interdependencies between activities performed to achieve a goal”* (Malone 1990). The theory suggests alternative ways of utilizing resources when their interdependencies are known.

With this backdrop, the theory establishes a setup as shown in Table 3:

Kinds of interdependence	**Common object**	**Example of interdependence in manufacturing**	**Example of coordination process to manage interdependence**
Generic:			
Prerequisite	Output of one activity which is required by the next activity	Parts must be delivered in time to be used	Ordering activities, moving information from one activity to the next
Shared resource	Resource required by many activities	Two parts installed with a common tool	Allocating resources
Simultaneity	Time at which more than one activity must occur	Installing two machined parts at the same time	Synchronizing activities
Vestbase comparison:			
Pooled resources	Resource required by many activities	Multiple jobs to be handled by work teams of varying configuration	Self-governing teams through pooling resources and work tasks

Table 3 Examples of different types of interdependence

This can be useful to create good tools for cooperation and, hopefully, it will give an opportunity to simplify and improve information management.

9.7 Empowerment and decision making

In the author’s own experience, issuing personnel at the lowest levels with advanced IT tools for performing work tasks is empowering them, something which usually leads to increased job satisfaction. The implementation has also led to employees’ participation in the development of such tools, as there has been substantial feedback from the users during the development and implementation period. (Malone 1997) is clear when it comes to empowerment and control through IT tools and it may be necessary to include some of this theory here, in order to gain more control over a future implementation process. Not all researchers are this indicative of a positive outcome of employee empowerment and these may have to be considered as well.

(Vidal 2006) states that: *'Lean production can achieve substantial performance improvements through better process control and enlisting workers in standardization, but without necessarily improving the experience of workers through empowerment'*. Considering the use of empowerment so as not to overestimate its potential positive effects therefore seems important.

9.8 Thought processes

Daniel Kahneman's theories on thought processes are interesting and have relevance here. Since pooling of customer orders here means moving decision making from Vestbase's customer center to individuals working in the field, this may influence how the end customer ultimately perceives the organization when it comes to such issues as mentioned in chapter 0.

Pooling of work tasks means that many more individuals will take part in decision making and it is therefore important that all decision makers act in a similar fashion to similar tasks, to achieve the same level of accuracy and consistency over time. It may be important to communicate responsibilities in a timely manner to the people involved, so as to avoid any misunderstandings in the transitional phase.

This has importance for HSEQ as well since this area of operations is a key element in the industry today. When people come under stress, they may start worrying about their performance (Kahneman 2012) and this may again lead to people taking short cuts and reduced work quality and thereby, also increased risk.

9.9 Arcs of integration

'All manufacturers implicitly make strategic decisions concerning the extent of upstream and downstream integration that they want to undertake' (Frohlich and Westbrook 2001). This statement leads towards the idea of integrating with suppliers and customers according to how much impact one wants to have on the operational performance of the overall supply chain.

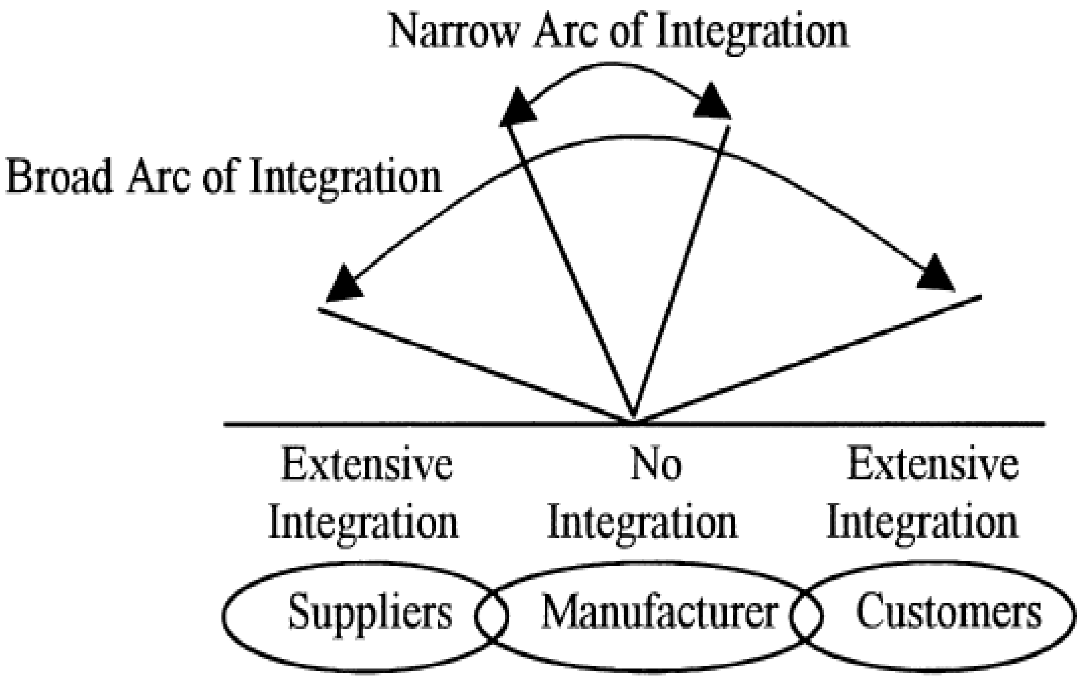

Figure 25 Integration scheme model

The model in Figure 25 shows to which extent one may integrate, and how the influence and effect on the supply chain will change accordingly.

It is interesting to see if Vestbase and Norseagroup would benefit from expanding its arc of integration further upstream, especially if it is possible to use this influence to, for instance, get an early insight into arriving cargo and corresponding cargo weights.

9.10 Green logistics

'Green Logistics analyses the environmental consequences of logistics and how to deal with them'(McKinnon 2010). This quote gives an indication on how any company can approach the challenge of reducing its negative influence on the environment through its way of doing business.

Many industries face this challenge today, and so does the oil and gas sector in Norway. Greening within the Norwegian oil and gas supply chain lies inherent in several contracts with Vestbase's larger customers. It can be therefore be interesting to see if this thesis can provide any indications to new approaches for reducing the negative sides of this supply chains' environmental impact.

10 Case analysis

Referring to the shortlist in chapter 10.1, six points will in this chapter be analyzed for current problems and potential improvements in regard of improving the supply chain and increasing Vestbase's contribution to it, through improved information management.

For simplicity, the text will often omit repetitive sentences and it is important to become aware of this fact. For instance, a term like *'via a front end system and an API towards LogisticsHub'* will only appear in any sentence that describes a possible solution involving software development if it is absolutely necessary for understanding the context.

10.1 Areas of improvement

Below is a shortlist of functional work areas derived from chapter 6.6. The list gives an indication on where the effort to implement IT tools for data collection should have good effect on the supply chain in an information management perspective.

- Loading and unloading of a variety of ship types
- Internal transport of cargo on the base area
- Technical services on lifting gear
- Bulk deliveries to and from ships
- OCTG and decoupling services

10.2 Existing problems and possible solutions

The following is a description on the most relevant problems that exist within the six areas mentioned in the above list as well as suggestions to how they can be solved or improved upon by Vestbase. The strategy will be improving tools and procedures related to data collection and information management.

10.2.1 Loading and unloading of supply ships

There are several challenges during loading and unloading of supply ships. One important factor lies in the loading lists issues by the customers. These are usually printed from the customer ERP system or from an Excel spreadsheet and unit weights are hand written onto the lists by the forklift operators.

The load lists come in many different configurations depending on the customer choice of setup, contributing to the complexity of the work tasks that operators are presented with. When a customer sends an order to the RMC database to load or unload a supply ship, this order does not currently include loading lists. These lists are usually handed out to the operators at the customers' terminal / logistics center. A considerable amount of non-value added work is done preparing and handing out and using these lists.

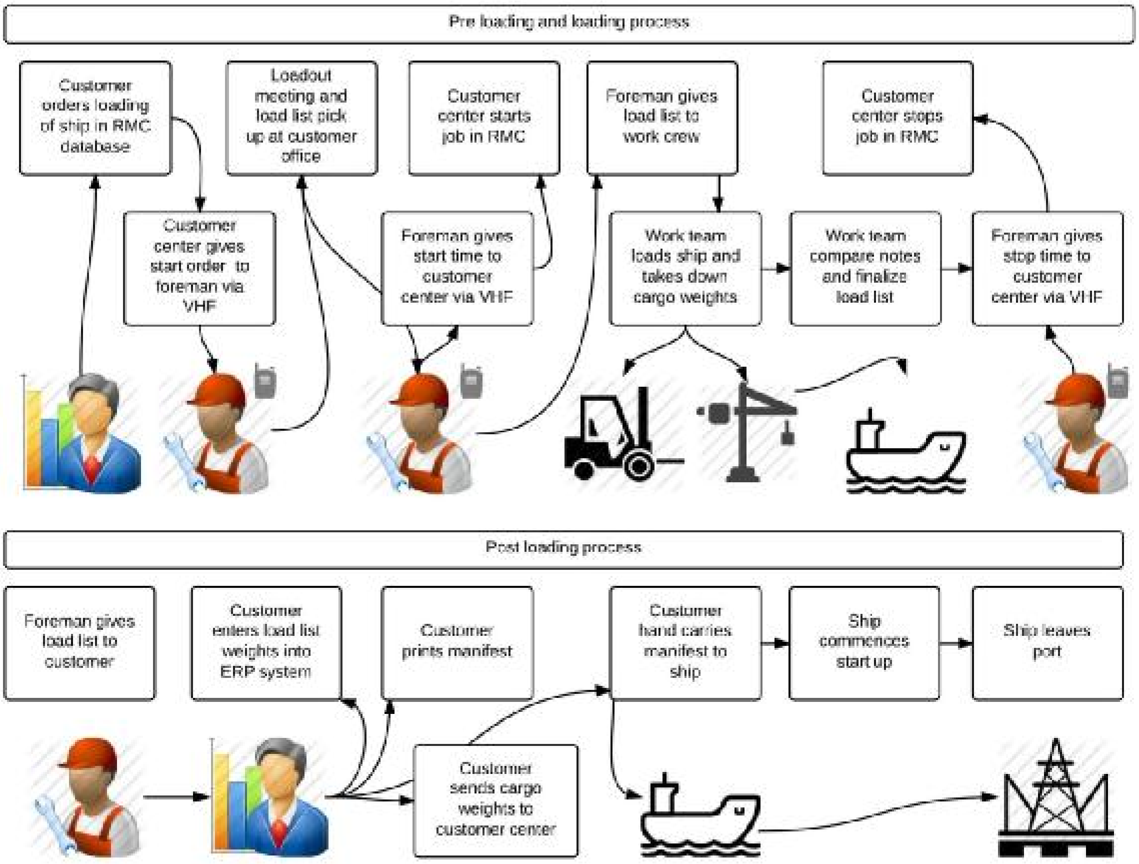

Figure 26 The current loading process for supply ships

As mentioned, loading crews hand write item weights on the lists before they return them to the customer for manual punching of weights into their ERP system. Customer personnel then punch the numbers into the system before printing the manifest and delivering it to the ship.

This is the only way information on containers' weights is collected today. The lists often have misprints and this leads to misunderstandings and people having to make contact with the customer office to confirm correct name / number on the container, creating delays and non-value added work and when the lists are returned to the customer, the recipient has to decode the operators' handwriting – another source of errors. Figure 26 shows how this process works today.

An estimated average of 30 minutes (Gravvold 2014) is spent from the last container is loaded, until the manifest is onboard the ship – a considerable time window that is both costly and wasteful when considering that this half hour is much better spent on letting the supply ships add value by being offshore servicing the oil rig installations.

10.2.2 Suggested solution

Considering the LogisticsHub database and how end users (e.g. supply base operators) can be given access to read and write certain information available in the system via smart phones and / or tablets, as is already in use to a certain extent (See chapter 8.10).

It should be possible to enable the automated rendering of electronic loading lists, where the operators can enter the weights of containers directly. This information can be relayed from and to the customer ERP system via an Application Programming Interface (API). (Simply put, API's enable incompatible software programs and databases to communicate with each other (Wikipedia 2013)). Making this system available to actors in the supply chain would enable entering of container information at any point in the chain.

Implementing this routine should be possible by utilizing the LogisticsHub database. By using a setup like the one shown in Figure 27, it would be possible to export load out and backload (return cargo from offshore rigs) lists for the loading crews and use internet connected computers / pads for tallying the cargo directly inside the forklifts and cranes as needed. This would remove the need for getting printed load out lists from the customer.

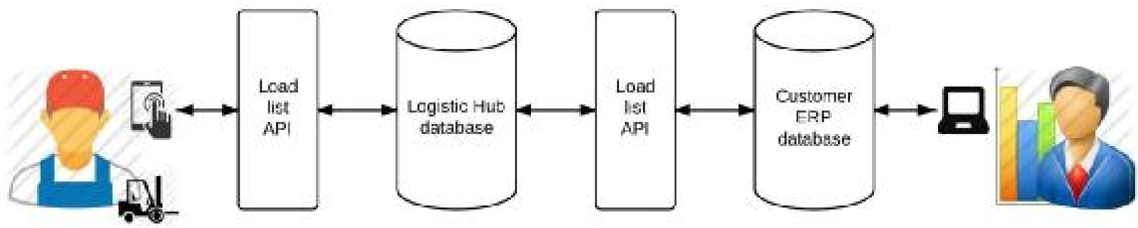

Figure 27 Electronic load list setup

The setup enables loading crews to work interactively with the customers ERP system by remote connection (similar to the setup shown in Figure 17), and reduces non-value added work as well as time spent for the terminal on entering numbers manually into the system.

By doing this, one can actually enter the weight of any container at the suppliers shipping site (actually whenever a container is handled by someone with access to LogisticsHub and the right API), reducing the need for reading weights of containers when loading them onto the supply ships. This shortens the time spent making loading information ready.

Containers packed at Vestbase can also be weighed and weights can be entered using the same API and front end interface. (If necessary, the operators who unload containers from cargo trucks at Vestbase can also weigh the arriving containers before they are put in the rig shipping zones).

As mentioned, the current routine means that a relatively large amount of time is spent on making loading lists ready for handover back to the customer and the customer also spends a considerable amount of time punching numbers (weights) into the ERP system, so a manifest can be printed and handed over to the supply ship. These manual activities would be avoided, if all container weights are in the system already.

LogisticsHub makes this solution possible as any actor can interact with the database through the development of API's and front end systems. Given the topic of the thesis, it would be in the interest of Vestbase to take part in this project. Both because this will reduce the loading / unloading time of ships, and also, since it will extend the company's arc of integration further upstream and possibly downstream as well. Potentially making Vestbase a more integrated participant in the overall supply chain.

Another benefit is that this will eliminate any misprints on container numbers and the need for interpreting hand written weights on the paper manifests. Forklifts that have RFID equipment as shown in Figure 17, will read containers' numbers automatically and this eliminates misprints as there is no need for typing any number into the system.

As the supplier makes his container data available in the system, any following actor can contribute with his own data if necessary.

So having cargo lists available in an electronic format is a better alternative for several reasons. In a good user interface, checking off a container on a screen (e.g. inside a forklift) will remove the item from the list, thereby shortening the list, making it easier to look through an already long loading manifest. The list can also be sorted alphabetically, (this is often random today) reducing search time.

Forklift operators often mention light conditions and letter size as problems when reading containers lists. Working at night, the forklifts have some internal lighting that can be used but the lamps are not giving very good reading conditions (according operators). Also, the letter size is a problem for many, especially the older operators.

Both problems lead to increased loading time and lower data quality and can be solved if load out lists are available on computer tablet screens, as the screens are illuminated and give very good reading conditions and the letter size can be adjusted as needed.

Since all containers can be electronically read into the system, the electronic export of data from different customer's ERP systems means that the loading lists can all have the same format, thereby reducing the complexity of the work tasks that the operators are presented with.

Also, supply ships can monitor the loading operation more closely and since the cargo weights are already in the system, available from LogisticsHub, the manifest for the cargo can be finalized early and delivered onboard before loading starts (or during loading). This enables the ship crew to make an earlier engine start up, as they will know approximately when the loading is finished, thus decreasing time spent at the base and increasing time available for adding value to the oil rig installations.

As mentioned in chapter 10.2.1 the potential savings on an average load out process is estimated to 30 minutes, however finding further improvements may increase the savings. As an example of the scope, one can let the ship's crew get access to customer ERP systems so they can access the final manifest(s) after departure (data sheets, load out lists and other papers will always be handed to the crew before loading commences). This will allow for even earlier departures and further time savings.

Integrating itself more broadly into the supply chain by using the potential that lies within LogisticsHub could benefit both Vestbase and the overall supply chain performance, as is shown by (Frohlich and Westbrook 2001).
They show that there is *'Consistent evidence that the widest degree of arc of integration with both suppliers and customers had the strongest association with performance improvement.'* The degree of integration may not have to be very large or extensive in this case, since we are only considering the movement of containers at this stage. Nonetheless, a wider integration seems both possible and desirable.

Assuming that to receive shipping information on containers as far out as the end customers' tier 2 suppliers, extends the integration for Vestbase wide enough to achieve the necessary level of performance improvement, gives a good starting point for approaching the problem. (Assumption is partly made from author's own assessment based on previous experience with this supply chain). The paper also shows that businesses having this type of integration have the greatest market share, profitability and return on investment.

Given that this is an indicator for businesses providing services as well, then Vestbase stands not only to improve the overall supply chain performance but it may also strengthen its own position in the industry. Figure 28 indicates how the reach of Vestbase's expanded arc of integration through LogisticsHub could enable less non-value added work on registering container weights.

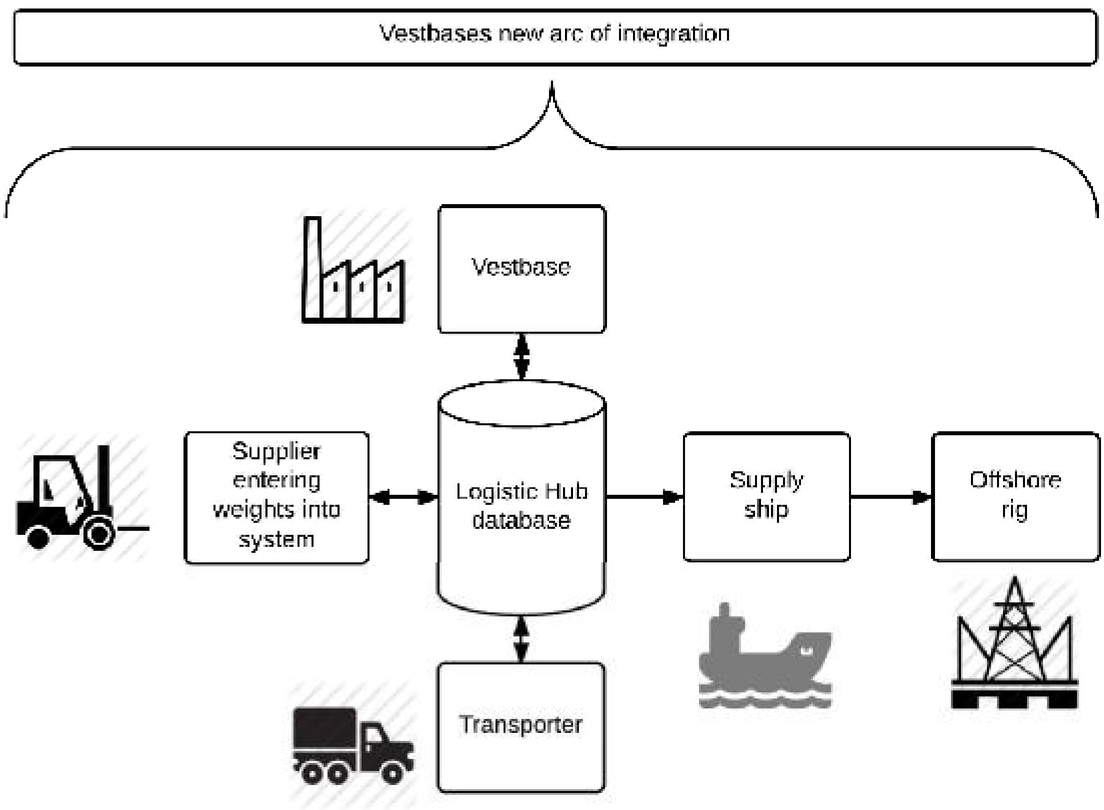

Figure 28 Extent of Vestbase's future arc of integration through LogisticsHub

The RMC forklift app described in chapter 8.10 can be developed further to include more functionality, for instance, one can easily see how more complex work orders can be handled by operators in the field, using the same computer pads as they use for the original app.

This way, the customer center only has to tell the foreman that a new loading job is available in the app system (and hardly that since the foreman can update himself on the available information by synchronizing the app). The foremen will follow their routine towards the customer when it comes to loading meetings but does not have to use VHF radio to tell the customer center when a job is started and stopped (see Figure 29).

The operators will start and stop their participation on any job through the extended app, and the customer center only has to keep serving the operators new jobs as needed. VHF radio will be used for urgent work orders and for transmitting other important information, such as changes in work team setup and any data to be registered that reaches beyond the user interface of the app.

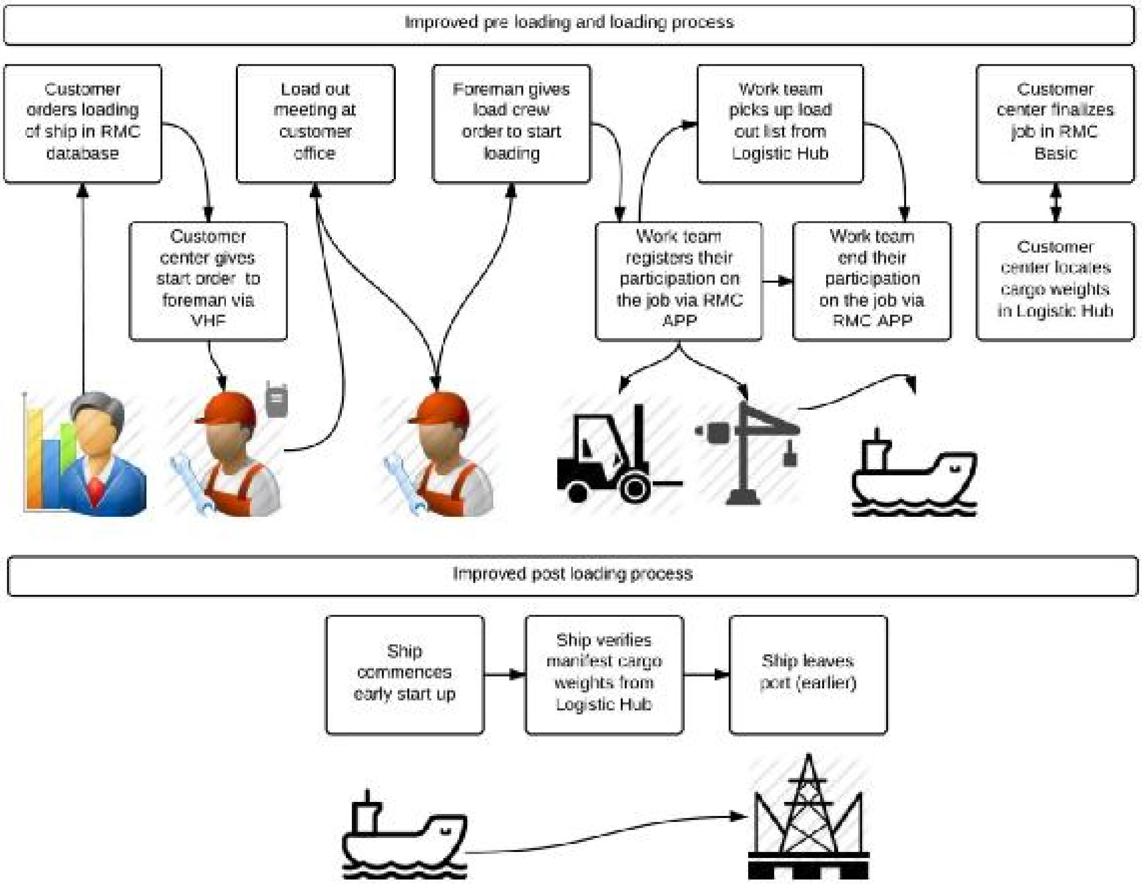

Figure 29 Improved loading process for supply ships

An obvious benefit here is the fact that the customer center's personnel is less involved in the process at the executive end and can concentrate its effort on quality assurance of the job (which they also do today). Registering of data is done by the operators in the field and this reduces non-value added work on each job for the customer center.

In turn, this gives the customer center personnel more time to work on other activities, and especially, more time to work on each task – a very positive improvement in light of thought processes (Kahneman 2012). This improvement should also give increased data and information quality.

Green logistics comes into play here as well (see chapter 9.10). At the customer's discretion, it is possible to use time saved during the loading process to reduce running speed for the supply ship, a choice that will help the greening of the supply chain considerably, given the standard supply ship fuel consumption.

Fuel consumption increases with increased speed for the supply ships and the following is an example of how much fuel can be saved going from service speed down to economy speed:

The PSV (Platform Supply Vessel - supply ship) Far Seeker, has the following fuel consumption (Shipping 2013):

- Consumption at Economy Speed: 14,5m³ / 24hrs @ 11,3Knots
- Consumption at Service Speed: 17m³ / 24hrs @ 12,2Knots

A reduction of speed by 0,9 knots saves 3500 liters of fuel per day – a considerable amount, especially when this aggregates with the number of days spent at sea.

Calculating the carbon dioxide production, this volume becomes about 9,5 tons of CO2. This volume can be aggregated to a number of supply ships that arrive at Vestbase and on a greater scale, all of Norseagroup's supply bases. Assuming 300 sailing days per year, and 25 supply ships, this turns into over 70.000 tons of CO2 saved - a significant amount.

A more practical example related to the potential of an extra 30 minutes sailing time, shows what can be saved in terms of reducing speed. (The sailing distance is chosen for simplicity but is realistic for the area of the NCS that Vestbase supplies).

Distance to rig	145	Nautical miles
Hours of sailing time @ 14,5 knots	10	Hours
New sailing speed for 10,5 hours sailing time	13,81	Knots
Reduction in speed	0,19	Knots
Fuel saved by 1 knot reduction	3889	Liters
Fuel saved per day at 0,19 knots reduction	741	Liters
Fuel saved on 10,5 hours sailing time @ 13,81 knots	324	Liters
reduction in CO2 emissions	810	Kilograms

Table 4 Fuel / CO2 emissions savings example

Experience shows that any time saved is used up on the first leg of the journey, as, for practical reasons, there is usually no controlling how this extra time slot is utilized between the different installations (Taknæs 2013).

An obvious alternative here is to keep normal service speed and have the supply ships add more value offshore – a choice that one potentially may have to evaluate for every departure. The question is how much extra value is in 30 minutes of service time, compared to a substantial reduction in CO2 emissions.

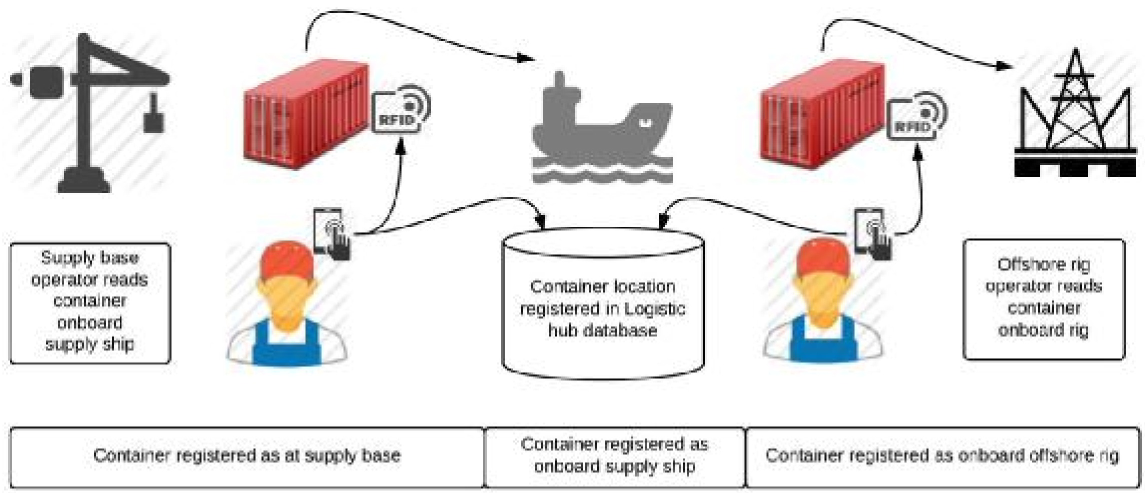

Figure 30 Setting CCU load out status

Figure 30 shows how the LogisticsHub system allows for manual update on any CCU's location and status. Automatic reading of load out status has proven too expensive so the current suggested setup will enable the operators to read necessary data instead.

The handheld devices utilized by the operators will read the container's load out position and set the database status on each individual container to for instance, either 'on supply vessel' or ' on rig'.

In order to realize this potential, a front end user interface with an API to the LogisticsHub database's container status data can be developed. Any container that has been checked off as loaded in the system (either manually by an operator or automatically by the LogisticsHub RFID system) will be read as belonging to the group 'Items loaded' and the rest is read as 'Items left'.

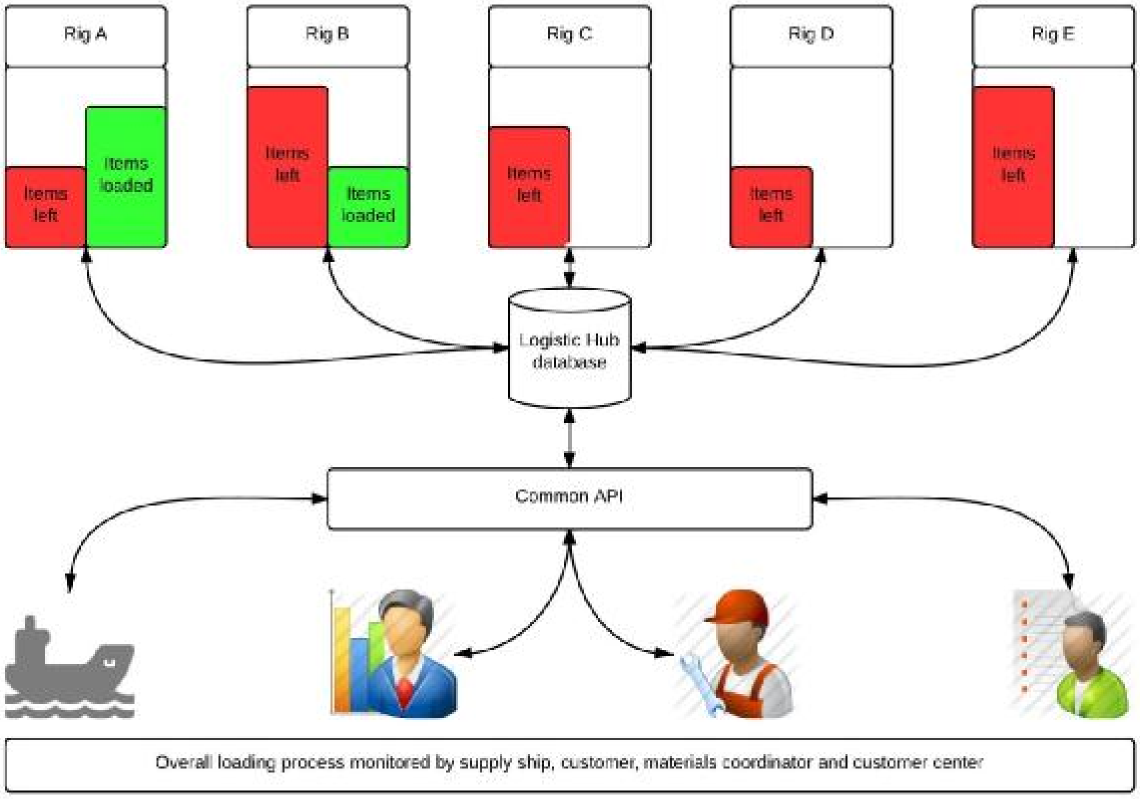

Figure 31 Monitoring the load out process

As is shown in Figure 31, the ship's crew can monitor the loading process and make an early startup to have the engines warm and ready for when the last container is onboard.

10.2.3 Internal transport of cargo at the supply base area

Vestbase handles many transport missions every day and these vary in size and length from short 10 minute jobs, to several hours of work from start to finish. The customer centers' personnel has to relay all of these to the operators and foremen via radio and / or the RMC forklift app, and this is a difficult task to perform without making errors, considering the amount of information that has to be handled within the current time frames.
Optimizing the utilization of the equipment and personnel pool often takes more time to solve than is available (Kahneman 2012).

A transport mission can often be temporarily stopped to be finished at a later time and the customer center has to handle all of these iterations without fail, or there will be unnecessary non-value added work before invoicing can be done. This is a difficult task and is today rarely performed without error, so improvement here is seen as very important.

The customer center has both internal and external customers. And in order to supply customers with these services, the customer center draws upon resources from the department for base operations. This department leases out all base operators, forklift and crane operators to the customer center which, in turn, uses these resources to fulfill customers' needs. This goes for both kinds of customers, internal and external.

Figure 32 shows how the customer center delivers services to both internal and external customers by drawing on the resources of the base operations department. All the information that needs to be gathered, both for invoicing purposes and else, has to go through the customer center, contributing to creating a large volume of information. As mentioned in chapter 6.6

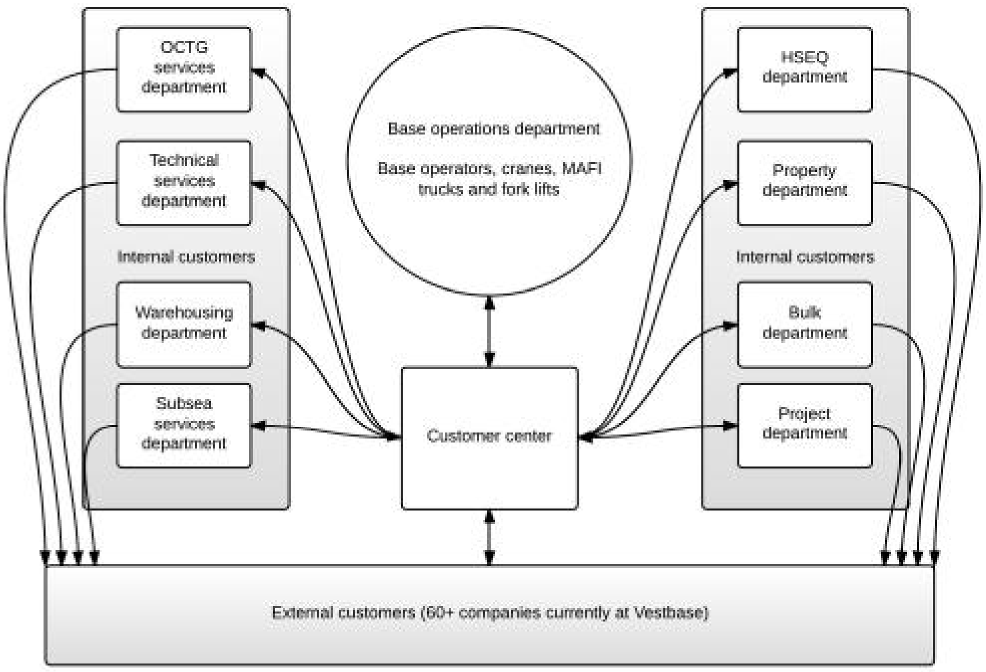

Figure 32 Current resource pool governance

10.2.4 Suggested solution

The customer center will forward some of the jobs that come in to the work task list (see Figure 12) so that they appear in the RMC forklift app for the operators to start and stop the jobs themselves, a solution that has proven both efficient and time saving. The forklift operators handle the tablets described in chapter 8.10. to perform this task.

A future solution could include the possibility of giving the customers access to the Google Earth map shown in chapter 8.11.

Since all vehicles and cranes are registered in the RMC database as individuals, it should be possible for any customer with access to find a vehicle that is nearby his location and suitable for the task at hand and then send job order directly to this unit via the RMC system.

The operator would get a notice on his smart phone / tablet that there is a request waiting for handling and can execute work task. Alternatively he can forward it to the customer center for further processing in case he is unable to do perform the task.

(This is how it works today also but it is only the customer center that can send these kinds of jobs out to the tablets. Also, no one else has the overview of all the vehicles on the base area, so it would be difficult for anyone else to direct orders to individual units). Figure 33 shows how one possible situation with this setup can come into play in many common situations.

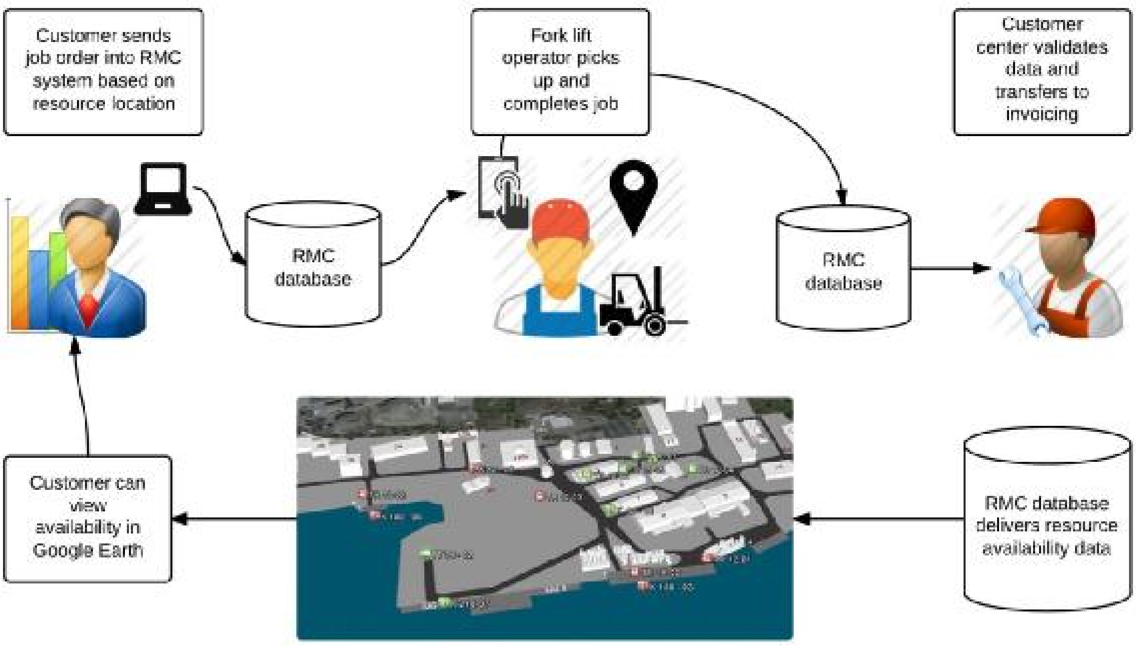

Figure 33 Customer order directly to operator

An alternative to this solution is to let customers indicate the location of the goods when making the transport order. Using an online map solution for giving an approximate location (+/- five to ten meters should be sufficient) means that the location information is digitized.

When the information is available in this form it can be used to give the RMC forklift app information on goods' locations. The app can then be made to show which work tasks are nearest the operator at any given time.

Implementing such a solution would include companies' resources for planning purposes and thereby reduce the current volume of information at the customer center and give the personnel there more time to plan remaining jobs, thereby increasing the quality of decisions made (Kahneman 2012).

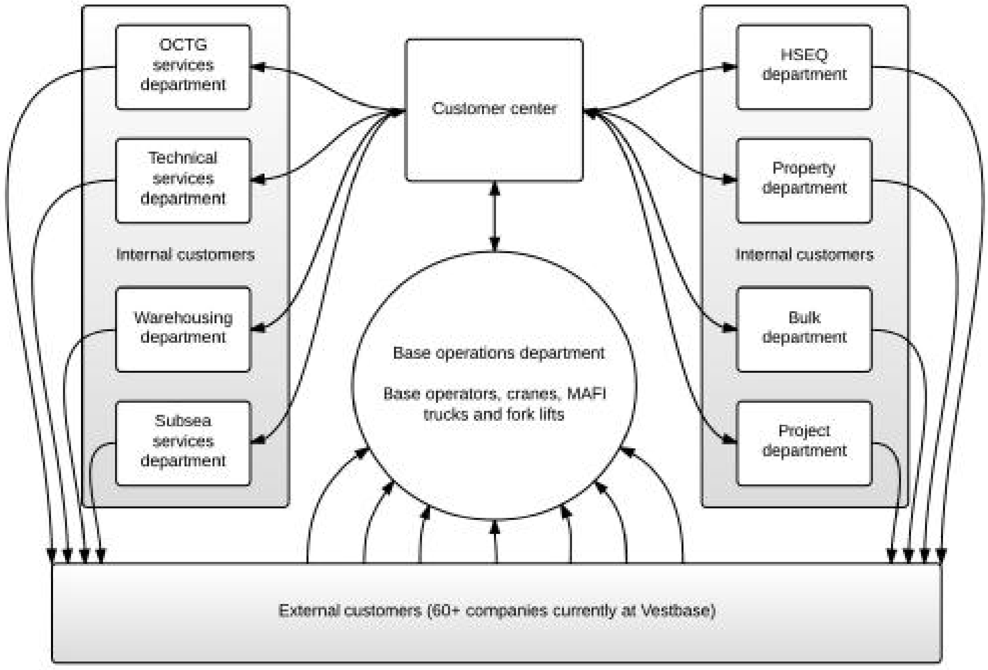

Figure 34 Improved resource pool governance

Figure 34 is derived from Figure 32 and shows this new setup and how it relieves some of the information load on the customer center. In practice, Vestbase will let customers take the role as 'customer center' for themselves, actually doing some of the planning work on their behalf.

This makes sense in the way that the customer often will have a better overview of the local situation and its own needs. Some evaluation should be done on how much and far reaching influence the customer should be allowed to do before such a solution is implemented to avoid giving the customer too much power on the overall logistical situation.

Also, this means that information on work tasks is made available in a way that enables a more decentralized organization, and should make the data collection activities more robust and reliable, since one is less dependent on a single hub for this purpose (the customer center) (Ori Brafman & Beckstrom 2006).

10.2.5 Technical services on lifting gear

Vestbase delivers technical services to a number of customers and these include checking of lifting gear on offshore containers before loading. The process involves both a foreman and technical personnel to perform the task. Figure 35 shows how the process works today, and as is usual, it includes paperwork, and an unnecessarily long chain of command.

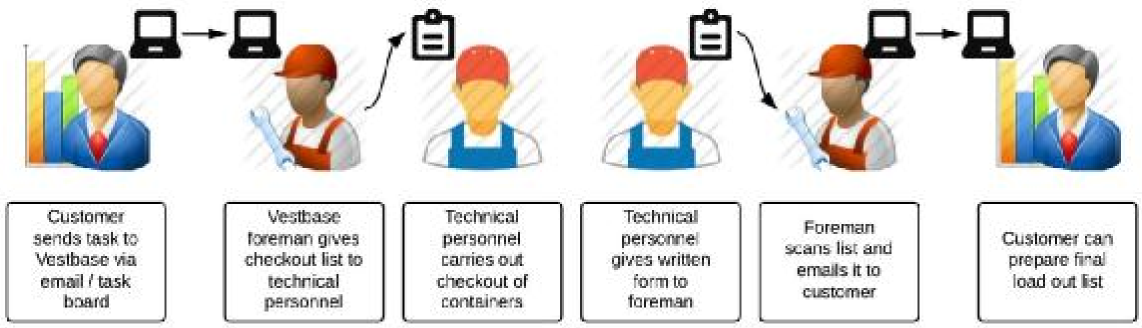

Figure 35 Current procedure for lifting gear check out

When the scanned list of checked out containers reach the customer, he can start finalizing the load out list by checking the containers' status as approved for shipment in the ERP system. This is also a manual job, due to the fact that all the information needed to complete it is on paper and not in electronic form.

10.2.6 Suggested solution

As both an efficiency measure and an improvement of HSEQ - the checking out of lifting equipment by technical services could be improved. Vestbase's technical department delivers third party checking of containers and lifting equipment. This service includes checkout of lifting gear on containers for shipping offshore.

All containers' lifting gear and general integrity are checked for certificate validity and physical damage before each departure and this is a daily activity for Vestbase personnel. It is clear that there is room for improvement in the same way as for loading containers on supply ships.

Today the personnel gets a paper list of containers ready for inspection and they use a paper form for each container to check off the individual inspection points, before handing the papers over for punching into the ERP system. Considering the fact that all containers and belonging information can be made available through LogisticsHub, it would be possible to make a list of containers ready for checking as well as a list of check points available electronically.

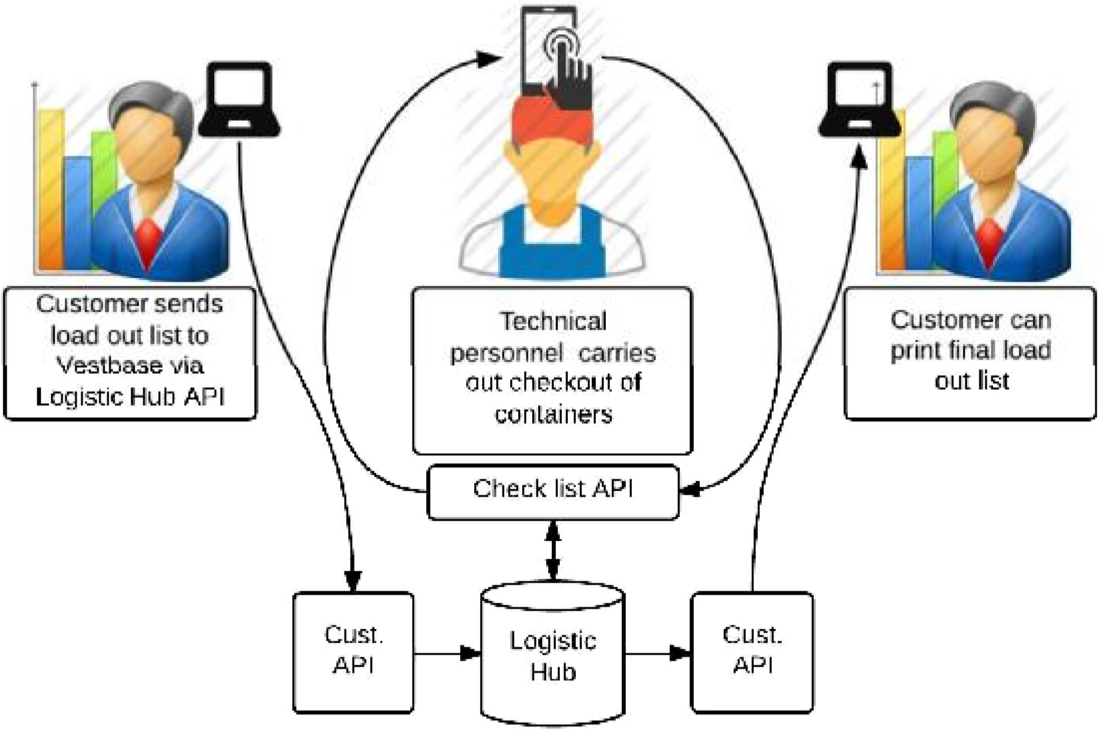

Figure 36 Future electronic check out setup

The list would be dynamic and will be updated as soon as anyone adds or removes containers to be shipped (Figure 36). This way, communicating changes so the inspectors can go through LogisticsHub, reducing the need for other types of communication (e.g. once a container is added to the list, it becomes immediately available to the inspectors (in the checkout list) which would carry smart tablets to lookup available containers as well as for entering data on container check points).

Any customer can send any container ID through to Vestbase's front end system via the API. This means that Vestbase can supply a selection of 'virtual' load out zones that the customer can choose from to let the technical personnel know where the containers are located.

(Currently this is the way things are done with the physical containers – all offshore rigs have their own load out zones at the supply base and this will make it easy for the crew to locate the containers).

This means that the crew can check out individual containers from many different customers, without having to wait for the foreman to hand them individual lists, which are usually not ready at the same time. Also the containers entered by the customers for load out, will appear in the checkout list as soon as they are entered into the system, providing another benefit, namely that the crew doesn't have to wait for the entire list but check out containers consecutively. T

his is very much in line with one of the aforementioned industry strategies, the Integrated Operations initiative (PSAN 2012), and it may be that this should become a highly prioritized development project for Vestbase.

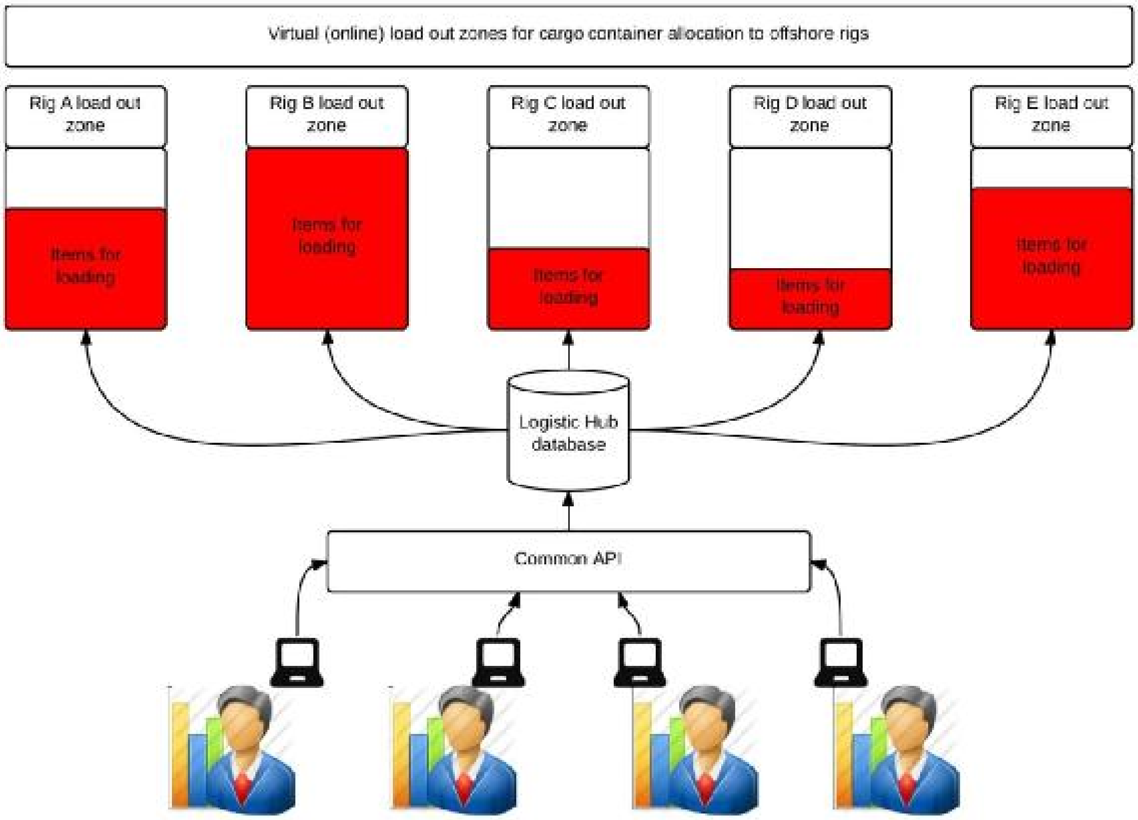

Figure 37 Virtual load out zones

To exemplify what is meant by a 'virtual load out zone', Figure 37 shows how a common API can enable customers to allocate containers to the different rig load out zones. This setup would make the basis for the monitoring of the load out process shown in Figure 31.

The setup will also open up possibilities for combining the data for situations like the one described in chapter 10.2.3. The customer can simply state cargo location and cargo destination, and this information can make out the basis for a transport work order.

10.2.7 Bulk deliveries to and from ships

Vestbase's bulk department handles the reception and delivery of several types of bulk products. These include products of both liquid and powder form, to be transferred to the supply ships by connecting them to the tank facilities using hoses. The products are moved using high pressure pumping systems.

The volumes consist of Marine gas oil (Diesel fuel), base oil (lubrication type oil) several cement types, weight materials, miscellaneous drilling fluids, as well as fresh water.

Combined volumes from Vestbase's bulk department and other bulk companies at the supply base for 2012 were about 16.000 tons of dry bulk and 520.000 cubic meters of liquid bulk of different specific gravities (the specific weight of one liter of the liquid). All in all, these volumes counted a total mass of over 750.000 tons (rough estimate) of materials Table 5.

		Jan	Feb	Mars	April	Mai	Juni	Juli	Aug	Sept	Okt	Nov	Des
Barite	IN	1 578	3 309	2 036	556	641	1 607		754	929	523	-	647
	OUT	1 517	2 532	910	842	1 177	798	610	360	662	380	304	1 569
Bento-nite	IN	31	27	-	211	25	88		5	52		-	135
	OUT	75	70	-	135	60	-		50	30		-	235
Base oil	IN		532	644	181	169	-	587	10	8	200	-	-
	OUT		180	50	-	300	194	80	120	40		-	100
Mud	IN	1 854	2 868	3 232	689	1 855	2 436	1 039	1 641	860	1 770	1 327	2 416
	OUT	4 000	4 238	2 410	793	3 584	2 927	2 422	2 039	2 866	2 176	2 852	4 644
Brine	IN	1 441	845	1 429	1 688	888	1 566	753	529	916	544	892	-
	OUT	982	4 887	2 040	4 066	3 160	3 425	3 046	4 280	1 362	447	2 842	1 510
Cement	IN	805	792	-	250	729	-	-	715	85	-	-	1 195
	OUT	1 070	227	-	600	345	345	-	350	215	164	166	641
Fuel	IN	14 325	5 698	15 331	12 848	21 133	7 585	20 779	15 977	14 371	14 214	10 966	11 345
	OUT	13 826	12 602	11 165	17 812	13 539	15 185	18 472	11 423	15 240	11 579	11 766	12 319
Slop	IN	2 397	1 708	1 208	1 444	2 367	174	514	410	586	473	424	322
	OUT	2 070	1 500	2 200	1 400	2 031	-	560	400	1 800	655	255	-
MEG	IN	680	490	-	1 008	473	713	660	759	602	664	871	956
	OUT	400	160	790	345	617	520	490	458	1 332	800	1 405	630
Cilica	IN	0	66	68	34	-	31	-	-	34	67	65	-
Water	OUT	25 813	22 847	19 652	18 513	19 832	20 303	22 812	26 605	30 492	21 361	17 852	19 769

Table 5 Bulk volumes loaded at Vestbase in 2012

These figures indicate the volume of work when one considers that the bulk loads enter the supply ships at a rate of 50 to 200 tons per hour, averaging 100 tons per hour, this gives 7.500

job hours, where most jobs involve at least two people from the bulk department due to HSEQ regulations.

Also, personnel from this department delivers services for other bulk vendors, for instance bulk operators often take shifts standing guard during certain loading processes (hose guard) as a security measure in case any leaks or overfills occur.

Their customers usually log on to RMC Net and make their orders through the portal and the bulk department personnel handle things from there. Work orders are usually communicated via VHF radio or face to face at the bulk departments' operational office (Figure 38).

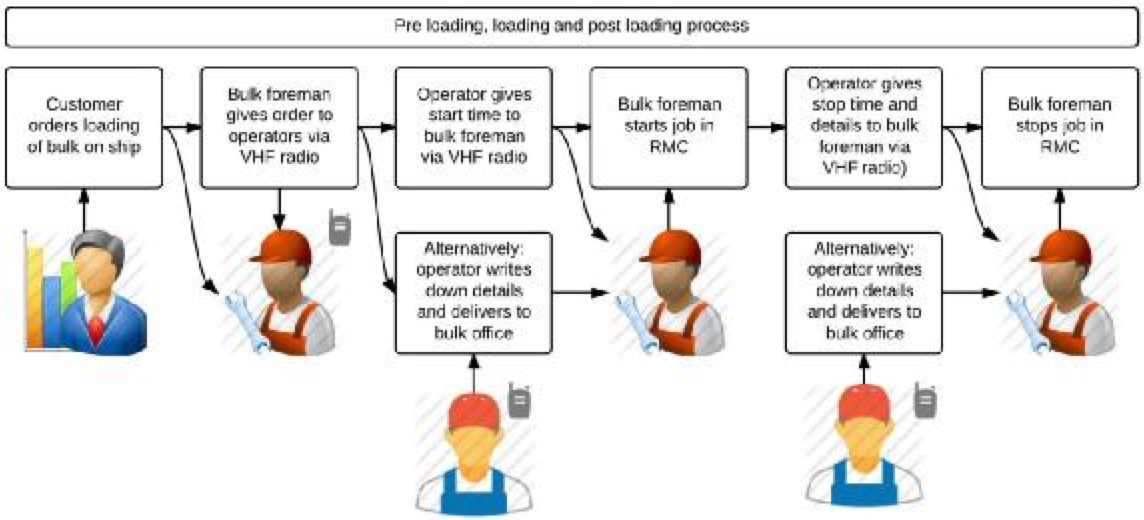

Figure 38 Current loading process bulk deliveries

The same problems that the customer center experiences, also applies for the bulk department, albeit on a smaller scale, as there are fewer people working there. The bulk office is operating with one working foreman. This person takes care of work load distribution and resource allocation, and also takes part in the daily loading and unloading operations as needed.

This means that the bulk office is not manned all the time, and work that has been done in the field, has to be written down and registered when the foreman is at the office. The bulk department reports all volumes loaded and unloaded to and from ships to the respective owner of the bulk load (sometimes that is Vestbase itself).

Reporting is mostly done on a monthly basis and per today, Excel spreadsheets are the usual documenting format. This is often regarded as an inefficient and not very up to date method sharing information and there is obviously a potential for improvement here.

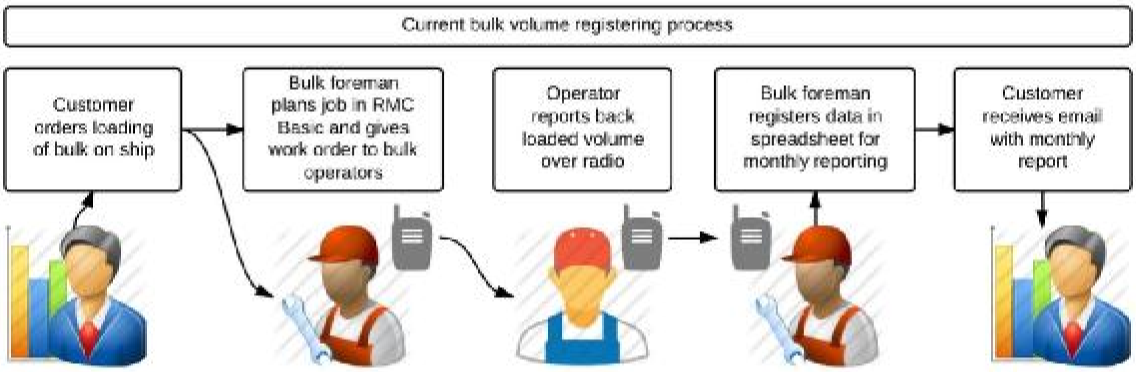

Figure 39 Current bulk volume registering process

Other suppliers of large volume bulk products have the same routines and it is interesting to see if their unresolved need for a better information sharing method can be included in a new solution from Vestbase. Also, as Figure 39 shows, there is non-value added work done in the registering process here too.

10.2.8 Suggested solution

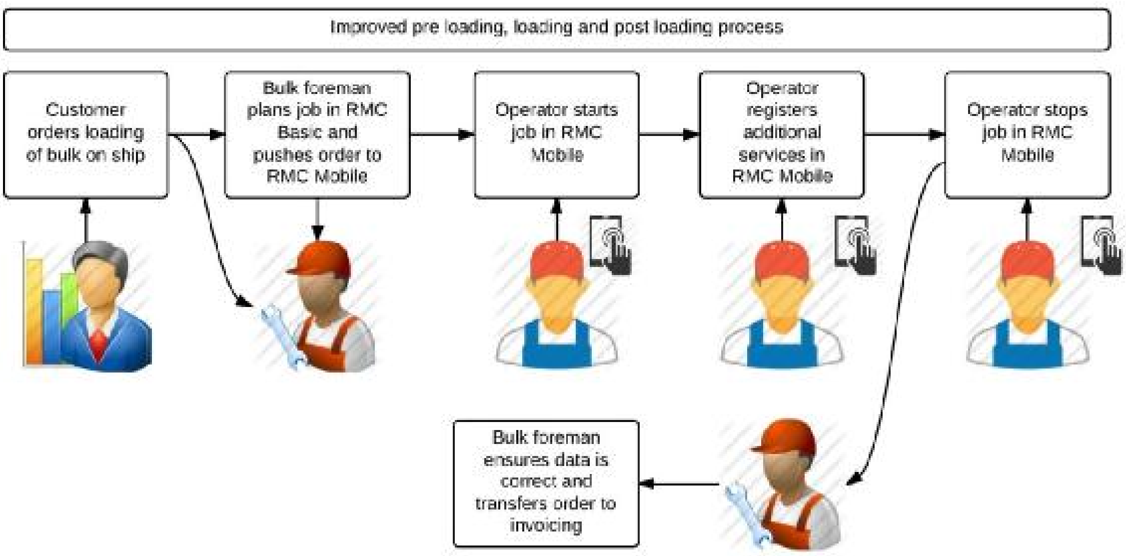

Figure 40 Improved bulk loading process

Currently, Vestbase is working with a local supplier to develop at quay allocation system called KAIA (KAI-Allokering – Eng.: Quay allocation) for allocating quays to arriving ships. This software will have several important functions, and one of these is that it will give all the companies that handle bulk loads within the base area, the ability to register amounts delivered and received in a web based system so that the information is available to relevant personnel, including bulk suppliers, supply ships and end customers.

As the KAIA system is still under development, there should be ample opportunity to include functionality to empower bulk department operators to enter final bulk loading data into the system, using tablets and / or smart phones as seen in Figure 40.

Figure 41 shows how Vestbase's bulk operators can contribute to entering data in KAIA when any bulk loading process is finished. There is no longer need for communicating the numbers to the bulk office foreman, as the operators enter the numbers themselves, making this part of the process more efficient.

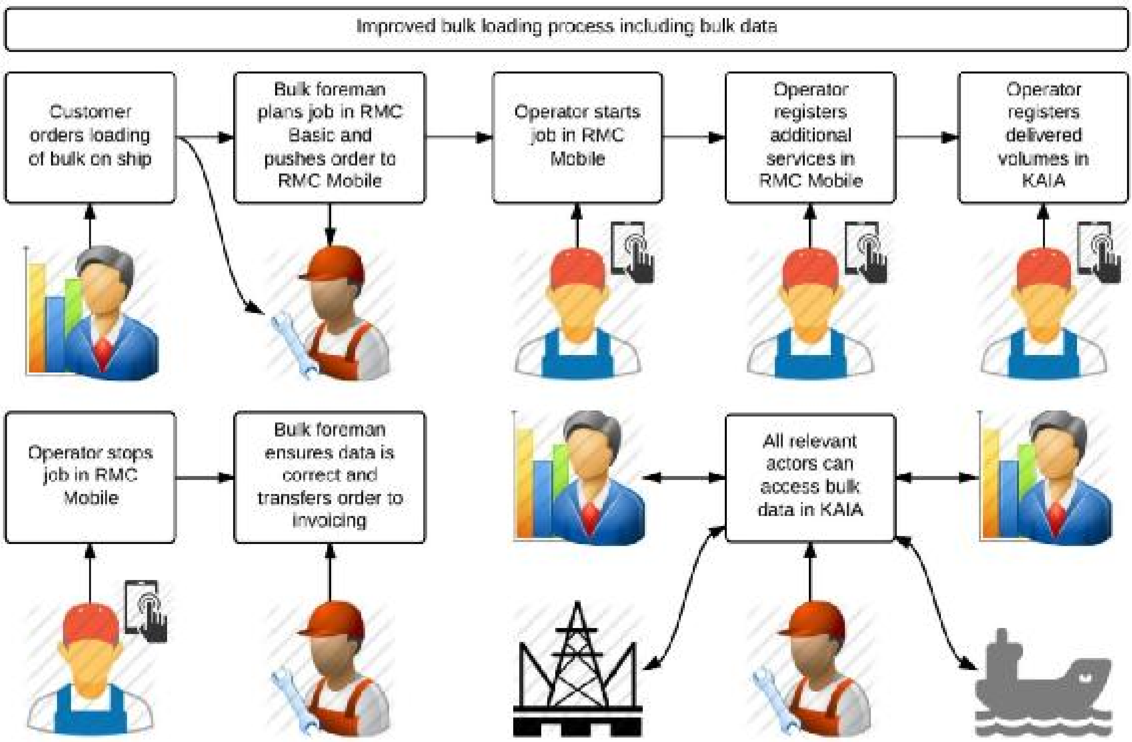

Figure 41 Future bulk registering process

The system can be set up so that it is possible for any actor with access (including end customers, bulk companies, supply ships and Vestbase's own bulk department) to download the data they need in a suitable format. Vestbase also report these volumes to the harbor department and national statistical services and KAIA would also simplify this process for the bulk department, as it would be possible to issue user names and passwords to anyone who needs to get these data.

10.2.9 OCTG services

The OCTG department handles casing for several customers. Casing is basically steel pipes that are used for lining the oil wells that produce hydrocarbons (Figure 42). The preparation of the pipes before shipping offshore includes checking for ovality (the 'roundness' of the pipes' cross section), control of threads and measuring the length of the pipes.

This is done by sub-contracting inspection companies at Vestbase. The casing inspectors make sure the measurements are made into tally lists for the offshore rigs to use when they run the casing into the wells (Figure 43). This way, the offshore rig can know exactly how long the casing string is when it's being run into the well.

Figure 42 Casing pipe long term storage stack

Another purpose of the tally list is to calculate how much casing is left after the running into the well is finished. This is done by taking the original tally list made by the casing services personnel and comparing it to the inhole tally made onboard the offshore rig during running of the casing. The inhole tally shows how many pipes were used for lining the oil well and by simple subtraction, one will find the number of pipes used. The remaining number of pipes is reported back to shore and stocks are updated manually.

Vestbase takes care of moving the pipe between the storage facility, casing inspection halls and load out zones, both on outgoing and on back loaded casing. The OCTG crews will mount lifting straps to the casing when it comes out of the inspection halls and load the pipes onto pipe rams for transportation to the load out zone. There can be several casing ‘packages’ stored in the shipping zone at the same time and keeping track of these is challenging and there have been mishaps where offshore rigs have been sent the wrong casing. This is obviously a problem that needs to be looked into as such failures can lead to down time on the rigs, which can be very expensive as shown in chapter 8.6.2.

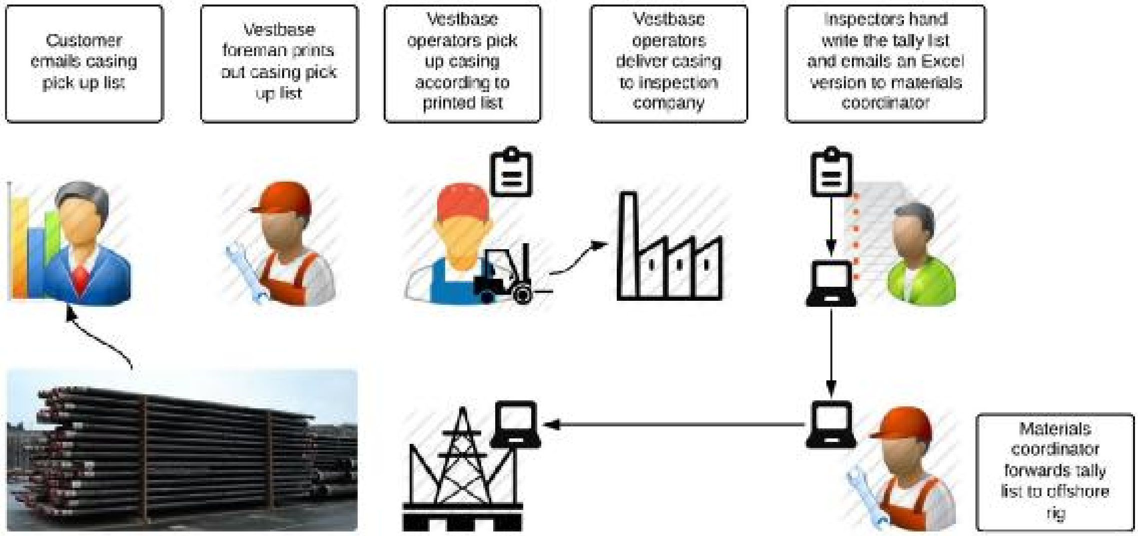

Figure 43 Current tally list procedure

The casing vendors deliver standard casing in lengths of around 11-12 meters. Oil companies need some of the pipes to be in shorter lengths and to different modifications, to fit with the different well types and drilling depths. Vestbase serves as a decoupling point by shipping casing to the different sub-contractors which will modify the pipes to customer specification.

Some of the work is done by Vestbase itself, such as dressing of the pipe and loading it onto racks at the thread inspection company and bundling the pipe afterwards. Also, Vestbase will load casing onto cargo trucks for shipment and treatment at other facilities in Kristiansund and Stavanger.

The work includes the following tasks:

- Making of pup joints (shorter lengths of pipe) – outsourced to 3rd party
- Making up[1] pipe with valve equipment - outsourced to 3rd party
- Bottom hole production equipment (prepared by sub-contractor in Stavanger)
- Dressing of casing with centralizers

Making of pup joints, fitting pipes with valves and making bottom hole equipment are all done externally and the only work here that involves Vestbase is the loading and unloading of cargo trucks for shipment to and from the 3rd party companies.

As for dressing (Fitting mechanical devices onto pipes as in Figure 44)of the casing with centralizers, (*A mechanical device that keeps casing from contacting the wellbore wall* (Schlumberger 2013) see Figure 44), Vestbase performs this work as a decoupling service for remote sub-contractors that hold local contracts with the oil companies.

Dressing is a job that currently involves hand written lists and also printed drawings to show where on the pipes the centralizers are to be mounted. All communication of work is done by radio and / or face to face with the operators and papers are handed over to them for work description. All in all an inefficient way of performing this task, as there still is a lot of data on handwritten lists that needs to be rewritten into a computer at some point.

Figure 44 Casing centralizers (Source: Centek)

10.2.10 Suggested solution

Considering the current method of storing tally information in an Excel spreadsheet (Figure 45) and how this sheet is utilized on a daily basis, it is not difficult to see why this is done. It is a simple and straightforward method and it has a widespread use in the industry. Most of

[1] Connecting the parts by their threads – just like a bolt and nut

the data in this sheet is just that – data. The column named 'Full Length', however, contains a formula that calculates 'make-up loss' (gives the effective length of the pipe after make-up) to calculate the nominal length that the individual pipe has when it is made up into the casing string.

This is necessary information when the complete string is run into the well, since the bore hole has an exact length and it is not desirable to make the string too long or too short.

The exact lengthwise contribution from each pipe after make-up is necessary to know as the bore hole is usually drilled with no more than one meter deviance and missing on the length here, will mean having to pull the string up and make adjustments to it – a potentially costly delay as shown in chapter 8.6.2.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1							*Casing details*							
2	**Work order:**				1037324 B		**Dimension:**		5 1/2"					
3	**Total Running length** (*m*):				964,431		**Weight:**		**17#**					
4	**Total Full length** (*m*):				973,422		Grade:		13Cr L80					
5	**Total pipes** (pcs.)				81		**Threads:**		Vam Top HT					
6	**Total centralizer** (pcs.)				0		**Drift dia.** (*mm*):		121,08					
7	**Total Stop Collar** (pcs.)				0		**Thread dope:**		Jet Lube Seal Guard ECF					
8	**Makeup loss per joint** (-*m*):				0,111		**Amount of Dope(kg)**		3					
9	**Length marked on joint:**				Running									
10	**Pipe no.**	**Tally no.**	**Dim.**	**Type**	**Running Length** (*m*)	**Full Length** (*m*)	**Centra-lizers**	**Stop rings**	**Thread type**		**WYKK/ BYFF**	**Heat Nr**	**Pipe NR**	**Comments**
11	1	1	5 1/2"	Tubing	11,984	12,095			Vam Top HT		811	F217091-705	98	
12	2	2	5 1/2"	Tubing	12,002	12,113			Vam Top HT		811	F217091-705	94	
13	3	3	5 1/2"	Tubing	11,810	11,921			Vam Top HT		811	F216038-704	97	
14	4	4	5 1/2"	Tubing	11,963	12,074			Vam Top HT		811	F217091-705	5	
15	5	5	5 1/2"	Tubing	11,973	12,084			Vam Top HT		811	F217091-705	2	
16	6	6	5 1/2"	Tubing	11,977	12,088			Vam Top HT		811	F217091-705	7	
17	7	7	5 1/2"	Tubing	11,919	12,030			Vam Top HT		811	F217087-702	160	
18	8	8	5 1/2"	Tubing	11,963	12,074			Vam Top HT		811	F217091-705	4	
19	9	9	5 1/2"	Tubing	11,916	12,026			Vam Top HT		811	F217087-702	157	

Figure 45 Inspection company tally list (source: Vestbase AS)

Tally lists can be stored in LogisticsHub just like containers are (one container = one line in the database and this goes for any other item as well, as long as the item can be individualized), and the lists are available through LogisticsHub to any relevant actor including Vestbase OCTG personnel, the operating company and not least the offshore rig that uses the tally list when the casing is run into the well.

Considering the ability that databases have to do calculations using web pages as a front end tool for data entry and to visualize the result (i.e. the Wolfram Alpha database (Alpha 2013)), it may be possible to let LogisticsHub do the calculations for finding the running length information from the full length information.

Looking at the requirements specifications for LogisticsHub, it is not apparent whether this is a type of functionality the database is going to have. Even so, it could be worth suggesting to EPIM's development team as a future implementation possibility.

Figure 46 shows how the situation is simplified by removing non-value added work. In addition, it is clear that information about the casing tally is made more available, and given a digital format, enabling a more efficient handling of both the data and the resulting information.

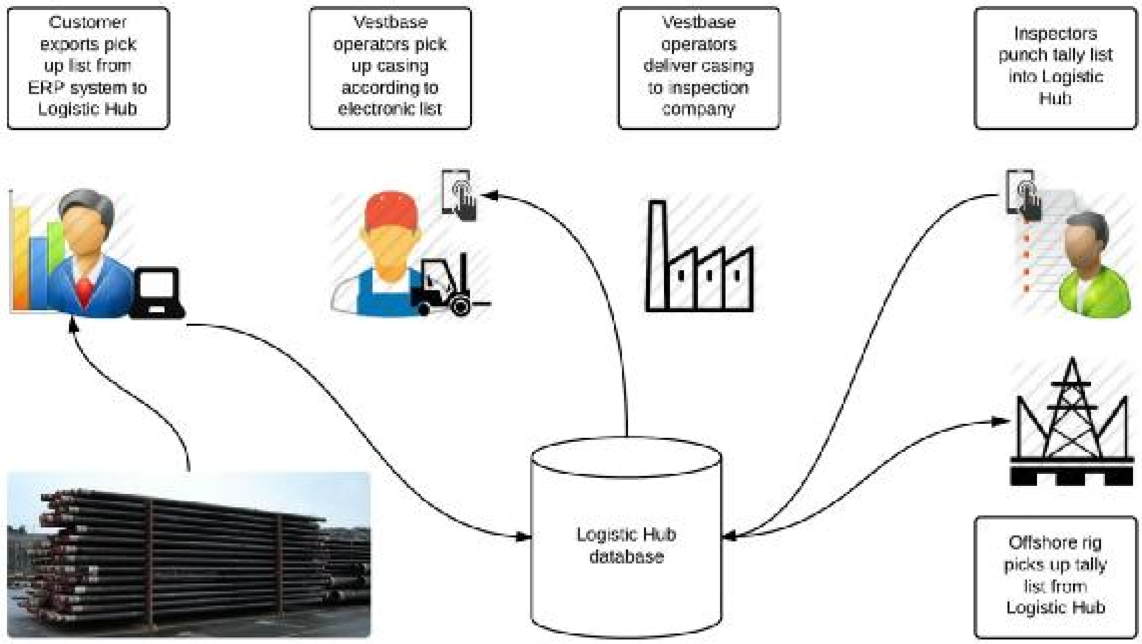

Figure 46 Future tally list procedure

For instance, the offshore rig can now access tally data directly from the LogisticsHub database and since the data is stored in this way, it can be downloaded as a report in many different formats.

When the tally list is made available in LogisticsHub, Vestbase personnel can access it in and register which pipes are stored on which pipe rams during the bundling process and the MAFI operator can register where in the load out zone the pipe rams are stored, by entering predefined zone area names. This ensures simple access to pipe rams during the load out process and also to individual pipes when this is necessary.

The setup also enables making prioritized loading of the casing, as the pipes often have to be loaded onto supply ships in a certain order. Pipe rams already have individual numbering and their individual loading order can thereby be entered by the oil company materials coordinator or even the offshore rig personnel casing responsible (Figure 47).

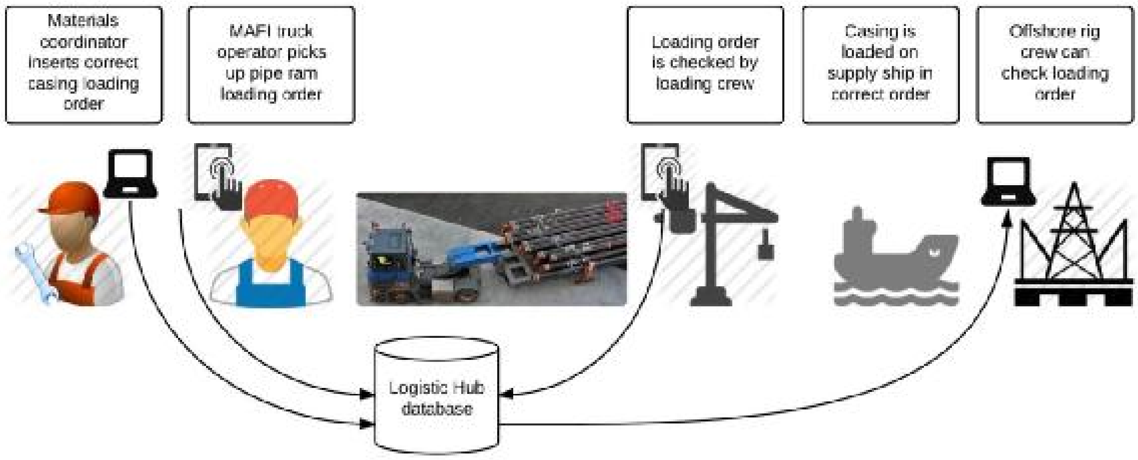

Figure 47 Loading of casing by predefined loading order

This also means that the offshore rigs can access the tally information earlier and start its planning process. In addition, the rig can give early feedback if there are any discrepancies to the tally.

As mentioned, the offshore rigs often use the original tally list to make a new list called an inhole tally list. This is a report of which pipes on the original tally has been run into the well. The inhole tally list has several uses and one of them is that it can be used to show which pipes have been returned to the supply base. This means that it is possible for the casing supplier to use this list for invoicing.

The most common contract form for acquisition of casing at Vestbase stipulates that the casing is bought as it is loaded onto the supply ship. The vendor will then buy the remaining tally back from the oil company when it is returned to the base, after a return inspection has been performed.

MIPS - Mitsui Integrated Pipe System – used by Japanese Mitsui Trading Company for warehousing purposes and sales is one such local system that has the potential for such integration (Aandahl 2013). Mitsui sells casing to customers via Vestbase’s facilities and there is an opportunity for API development for further integration here as well.

Combining the original tally list with the inhole tally can give both vendor and customer an updated and correct volume of purchase in a very simple way. The work of collecting the data is already done and the data can be combined, by integration between LogisticsHub and local systems (Figure 48).

When the casing inspection company releases the pipes from the inspection hall, Vestbase OCTG personnel selects a certain number of pipes for dressing. The selection is random and since the pipes are individually numbered, it is interesting to know which individuals have been dressed and which haven't.

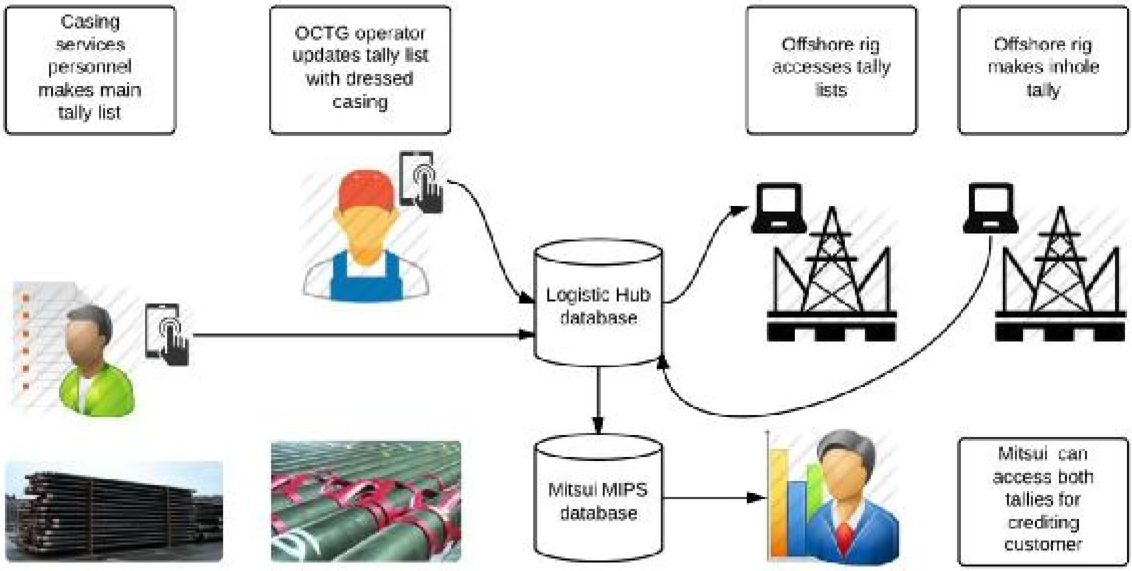

Figure 48 Creating invoicing data from tally

The inspection company could use the LogisticsHub database to select casing for dressing, and OCTG personnel can access this list, and pick the pipes as they exit the inspection hall.

However, this would be a complex task for OCTG personnel since the pipes will come out randomly. Therefore an optimal procedure would let the OCTG personnel pick random pipes and then enter the pipe individuals as dressed in the LogisticsHub database when they have finished dressing the pipes.

The need for OCTG equipment to be loaded onto or from cargo trucks is easily communicated to the operators and performed by them by using a system setup as shown in Figure 49. This would only involve the RMC database as there is no need for exchange of data between LogisticsHub and Vestbase's personnel to communicate such jobs.

A successful development and implementation of such functionality in the system here could bring about some inherent coordination capabilities that will help improve both the data entered in the LogisticsHub database and also make this part of the supply chain more efficient and effective.

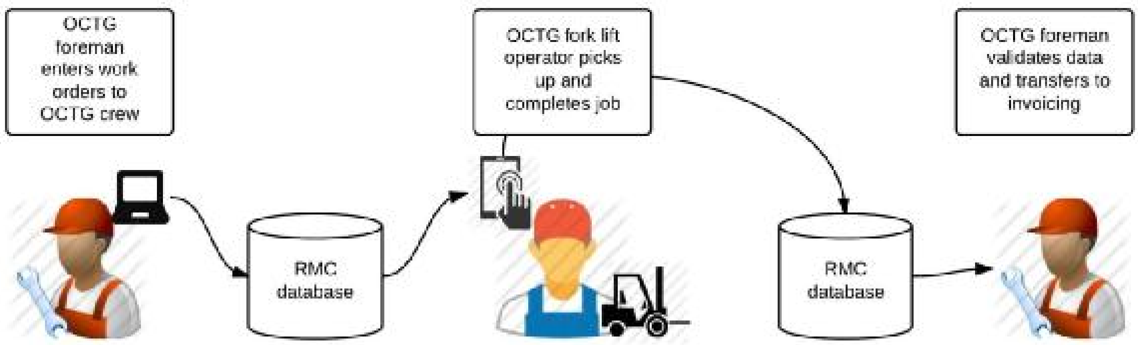

Figure 49 Simple work distribution setup

The setup is quite similar to the already established RMC forklift app as mentioned in chapter 8.10 and any job that has a composition that is within the scope of the app, can be handled in this way today. Jobs that require more resources than one forklift and one operator cannot be run with the RMC forklift app – that would require further development.

11 Implementing new software systems

It has become clear during the work with this thesis that the chance of compability problems occurring between software systems is negligible and it has therefore not been mentioned much in the text. Experiences that Vestbase's development team has made in this respect, relates more to psychological issues on the end user level.

'There is a lot of psychology in this' is a term often used whenever Vestbase's development team is discussing the making of a new function or a change to any of the existing systems. The expression relates to experiences made whenever a change has been made and clearly indicates a resistance in the staff body that has to be taken into account. The general experience is that this sometimes also goes for end users outside the company, and it is probably here that the biggest challenges lie, in terms of implementing new modules to the LogisticsHub database.

Implementing RMC Mobile for instance should not provide problems within the staff body in Vestbase, as the operators are well aware that new systems are being developed and there is no problems getting participants to the trial phases of the implementation periods.

The operators who are reluctant usually get into things a little later, and by the end, the operators end up pulling together with a will to deliver high quality services throughout the local supply chain. It is also apparent that individuals are motivated by new tools that will give them more control and influence over their own work situation.

Getting everyone to cooperate and use the developed software tools is a major challenge, and Vestbase has struggled with this during the implementation phase of RMC. Vestbase's development team should make sure that the new tools are not only user friendly, but that they give the external users visibly added value, as one cannot expect external users to be willing to contribute in only adding information to the database without getting anything in return.

Some of the suggested solutions involve customers as active participants in the development and implementation phase as well as in the production phase. Vestbase will probably benefit from preparing the potential companies and their users through for instance such channels as a user forum and gatherings.

In order to get external users to start using the tools and interfaces that Vestbase will deliver, one may try to make a system for Vestbase to use internally first, thereby demonstrating functionality and success rate to other potential users. The RMC system is a good example here, where many customers have seen that this is a system that makes them more efficient and that it provides more than just a portal for ordering services.

Vestbase has managed to show their customers that they get other benefits, like historical data, early invoicing data on both accounts payable and receivable, as well as the ability to make orders from anywhere, as long as there is an internet connection available (Taknæs 2013).

Another method that has been used with success is to get an operating company to give their support for the projects. If a major oil company says it wants to implement something, the other actors will follow, due to the operator's strong standing and power in the industry.

The LogisticsHub project is a good example here, where one of the major participants has used its position to make all major supply bases in Norway take part in the implementation of RFID technology as part of their systems.

Furthermore, it is the author's experience that one should be aware of the possibility of alternative uses for the tools that are developed. Such occurrences have been observed several times during the development and implementation processes of RMC Basic, and there is ample reason to believe that such opportunities will occur during development of future software systems as well.

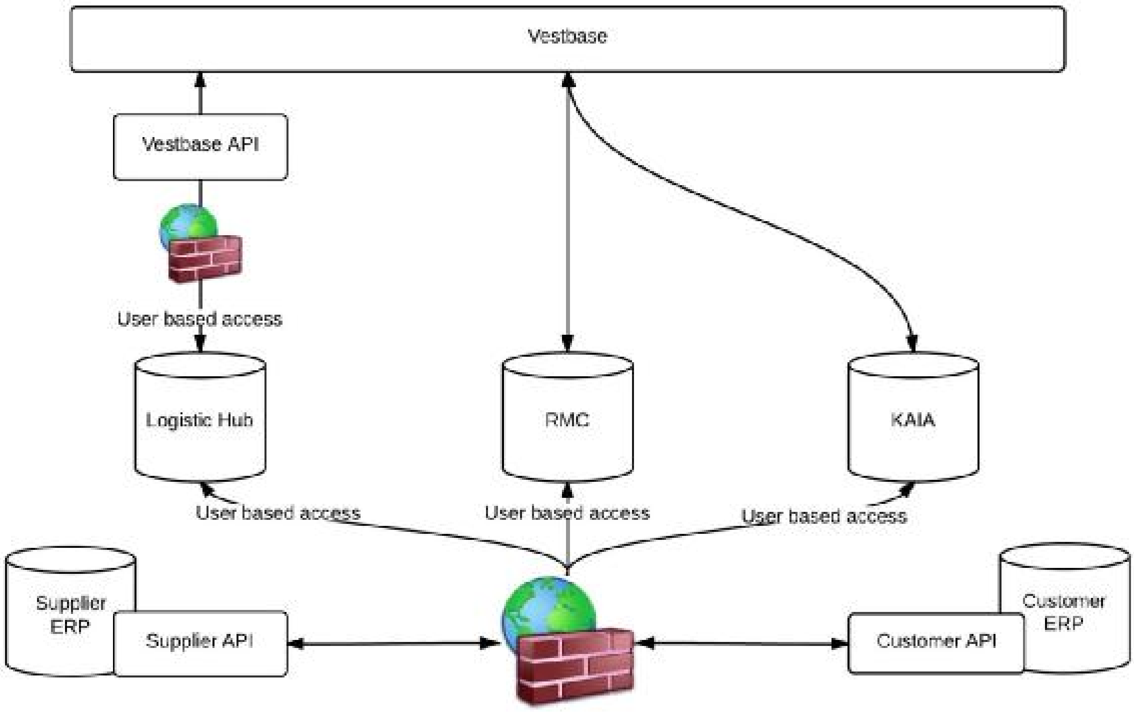

Figure 50 Securing contributor's data in LogisticsHub

Throughout the preceding chapters, lies the potential of sharing. Any data that is available electronically can usually be easily shared with others, provided that the data is located in a place where it can be opened up to external interests. Figure 16 gives an indication of how companies' individual data should be protected, through giving individual users access rights according to who they are and what kind of information they need, without giving anyone access to any confidential data or information.

As mentioned in chapter 8.7.1, confidential information should be handled carefully and Figure 50 shows a simple setup for ensuring ownership and keeping data secure, so that any fears of unrestricted access to individual companies' data can be avoided.

Developing systems like the ones described requires computer programming skills as well as knowledge of what the different actors in the industry need and expect from the supply chain in regard of information. Vestbase has been hiring software development companies for this purpose steadily since 2007 and has a lot of experience with such projects.

This has been a successful method for the company so far, and there should not be any problems associated with continuing with this strategy. Also, the company has thorough knowledge of their customers' needs, so finding solutions for good API's and user interfaces, should not present Vestbase with much of a challenge.

Implementing any of the suggested systems mentioned in this text should be straightforward for the company. Vestbase's own personnel are familiar with this kind of development and change and this is where the early development and implementation efforts should occur.

12 Conclusions

Many of the companies operating in the petroleum industry still have a long way to go when it comes to mastering supply chain management for offshore rig drilling and production needs and Vestbase can use this situation to become an important part in a necessary and long overdue development phase.

By utilizing the software systems currently in use in Vestbase better, through developing new interfaces for data collection, information management issues that the company is struggling with, can be solved. Vestbase will also get advantages by being in front of the development, bringing the company some strategic advantages in the form of forward knowledge and being the leading actor among its closest competitors. At the same time, Vestbase can decentralize data collection efforts in the local supply chain, to increase data volume, quality and availability.

The new tools will also simplify assignment of the different work tasks to the right groups and people and also help share information among the actors who need real time access to the collected data and the resulting information. It is important that the people with the right skills do the jobs they are suited for, in the type of work Vestbase's personnel does, and this setup can help make sure good and safe job allocation is possible.

Any of the solutions suggested would also be giving the Norseagroup Corporation a stronger standing in the industry as well as the opportunity to reduce non-value added work, overall cost of operations, increase operational efficiency for customers and increase the internal supply chain performance.

For further improvement of the supply chain that Vestbase is a member of, new tools for connecting and interacting with other parties' information systems should be developed. Provided that Vestbase is able to establish agreements with other companies, it should be possible to implement a system for inter-company data and information exchange that will improve the overall industry supply chains' efficiency as well as improving HSEQ.

Even though the most prominent actors in this supply chain have their own standalone ERP systems that provide functionality for data collection and information management, the data flow can be improved in many respects, as shown in this text, and this should inspire development cooperation across company borders.

Many of the different actors have common interests here and Vestbase's future efforts as described in this text can contribute to more integrated operations between them.

All in all, the suggested solutions for improving data collection and information management can impact the overall industry supply chain in several ways, as well as giving Vestbase, and its parent company, the opportunity to become a more important and influential actor in its part of the oil and gas industry.

13 Further work and limitations

Integrating Vestbase into other supply chains by developing a front end system that will enable entering of cargo weights on CCU's should be a relatively simple project for Vestbase, given that it is possible to achieve cooperation with the LogisticsHub project owner. This level of integration can reach throughout the industry supply chain and should be interesting for Vestbase and many of its partners.

It could be wise to look into the possibility of establishing a wider reach for entering container weights. Using LogisticsHub, tier 1 and 2 vendors can enter cargo weights as containers and goods are loaded at their plants. Implementing this through LogisticsHub is a large task, not so much because of development costs but more that there are so many actors in the system that will have to be influenced into using it. Again, having LogisticsHub project owner participate is important.

Finding a good solution for data storage for systems not related to LogisticsHub enabling easy sharing with external interests without compromising the data is crucial to a successful implementation and future integration into the main supply chain in the industry.

For external presentation of data, the report making capabilities of Automate are probably enough to serve most of the interested parties' needs. Excel spreadsheets are generally seen as an unproductive place to store information and more suited as a reporting tool. This is where the Automate program is used. Vestbase is using Automate to create reports on many different issues from personnel overtime use to the number of new jobs and jobs underway in RMC, as well as many other areas of the company's activities.

Looking into how Automate could be utilized externally is interesting and could also provide a way to create interest and support for new software solutions among Vestbase's customers and fellow supply chain participants.

The KAIA system will eventually contain a lot of data and the intention is to share these data with relevant users (users who contribute with information to the database). There is a least two ways to give users access to these data; by using Automate to set up reports and by letting the users themselves have access to KAIA functionality that will allow them to download raw data for creating their own reports.

It also seems pertinent to find out if the LogisticsHub database system can be made to perform simple calculations online, as suggested in chapter 10.2.10, since this would be a prerequisite for implementing an online tally list solution.

It is worth looking into securing computer equipment from damage since the end user environment often is harsh. The current test status is that any tablet mounted inside a forklift is relatively secure from damage and the few losses that have occurred are so small that any effort on ruggedizing the tablets would have surpassed the overall cost by far (Taknæs 2013).

There are many types of protective equipment and ruggedized tools available and Vestbase will most likely benefit from using some resources on this, as future implementations will include a less secure and more volatile end user environment. The reason for ruggedizing would rather be to achieve a higher operational up time and avoid inefficiencies due to damaged, broken or malfunctioning hardware.

Limitations in this text include unknown variables such as other companies' willingness to take part in and cooperate in the development and implementation of new systems, as well as any upcoming security concerns among these participants, both beforehand and during the process.

It is not necessarily straightforward to make customers agree to let API's have entry into their ERP systems. With this in mind, Vestbase would probably benefit from making a pre project assessment, to avoid getting into a development project that will not be implemented because of lack of participation from end users. One cannot know with certainty whether companies and their end users further up- or downstream in the supply chain will adapt to a new way of accessing data (like for instance the module for creating tally lists).

Considering computer equipment, the choice of platform (operating system) is also a relatively uncertain issue to consider in terms of development cost and time. There are several systems to choose from, Windows Mobile, Apple's iOS and Android are the three most prominent ones.

The reason for this necessity is that developing for more than one platform brings more cost and since different companies have different strategies here, it is important to find a solution that will benefit all the participants without having to take an all platform development cost. The more platforms to consider, the longer time it takes to develop the software, and this has an impact on implementation time and support work in general.

It is in the author's experience that once a software development and implementation project starts to pick up pace, it is important that the overall time frame is as short as possible, so as to avoid letting resistance against the new system to grow at the end user side.

Another potential limitation is that there has not been time to do interviews and collect data from other companies than Vestbase in this process. This may be a source of weakness when it comes to suggested solutions that involve exchange of data and information across company borders, and further research may be necessary here.

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15 Appendixes

15.1 Appendix A - Interview research questions

The following questions have been presented to interviewees during the research:

- How do orders come in to your department?
- How are orders communicated to operators?
- How are the various jobs performed?
- How are data registered and who registers the data?
- What kind of challenges does your department have in regard of logistics?
- What would be a simple description of your part of the supply chain?
- Do you see any practical challenges in regard of implementing a new system?

15.2 Appendix B – List of interviewees

- Viggo Bentzen, Foreman, bulk department
- Thomas Aandahl, Team Lead, OCTG
- Ann Elin Reiten, Foreman, OCTG department
- Cecilie Ødegaard, Team Lead, warehouse and personnel inhousing
- Rune Bratset, Team Lead, warehousing services
- Kjetil Øien, Team Lead, customer center
- Tore Skalde, Team Lead, support and logistics services
- Bjørn E. Rovik, Foreman, subsea warehouse services
- Paul Helseth Team Lead, technical services
- Guvnor Gravvold, Coordinator, customer center