

IT-ENABLED PROCESS DEVELOPMENT

A CASE STUDY OF THE PURCHASING CHALLENGES OF A PETROLEUM LOGISTICS FIRM

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Abstract

Supply chain management (SCM) has become a strategic and competitive “tool” that is increasingly recognized while purchasing has now assumed an equally important strategic role in business organizations. Purchasing has evolved from a mere buying function into a strategic function. It is a critical driving force in the strategic management of supply chains. This study looks at the purchasing function through a narrative produced by a case-study of a company involved in offshore petroleum logistics services. This includes detailed event descriptions of purchasing processes and three unique quality-related episodes from this studied offshore drilling service firm including modelling information exchange, as well as information system (IS) use. The frame of reference developed is the resource-based view of the firm and from a SCM perspective, purchasing and information use in this business function. Through this single case-study, uncertainty is evoked as a prime challenge of the purchasing function. Inspired by the resource-based view as well as SCM it is suggested that a focus in terms of information system development be placed on the purchaser and how this business actor is supported by information. This process of purchasing development is envisioned as incremental and continuous, involving occasional steps of radical innovation and must be embedded in a strategically enabled context.

Keywords: IT enabled process development, purchasing, petroleum logistics, supply chain management, resource-based view, supply chain information systems.

1 Introduction

By the end of 2015 the price of Brent crude oil had been reduced by more than 50% compared to a year earlier. This initiated a new price regime for relatively high-cost Norwegian oil production. Offshore petroleum logistics is concerned with supplies used to support oil and gas production. In Norway, where this case study of purchasing has been carried out, production takes place at offshore locations. The oil and gas market represents the economic context of this production. "Petroleum logistics" denotes a wide range of services associated with supporting the production of oil and gas raw material. This form of production involves a network of more or less integrated companies such as supply bases including industrial parks and harbors, specialized shipping, engineering services, drilling services, catering, helicopter transport and waste management. Given the tradition of high profit margins, these services have evolved into highly priced offerings purchased by the oil company producer. Inefficiencies in this sector are accordingly networked.

Purchasing is a vital function supporting petroleum logistics, and thereby indirectly supports offshore production of petroleum raw material. Much of a company's expenditure flows through the purchasing function. The complexity of industrial networks found in petroleum logistics tends to cloak cost transparency simply because there are so many different firms working together at the same and different times. However, given the heightened awareness of the need to improve performance in petroleum logistics, these service suppliers are increasingly feeling the market pinch and the heightened demand to cut costs in their market offerings. Furthermore, as the activity level in the offshore petroleum sector dwindles, competition is increasing between alternate petroleum logistics suppliers.

Given that purchasing is associated with service output quality, it therefore requires an effective and efficient organizational setup. This includes the use of information resources based on this study which focuses on firstly describing existing problems associated with purchasing in a firm providing offshore petroleum services. Based on this description the potential for IT-enabled process development are discussed. This implies mainly considering a strategic, more long-term view of how IT may facilitate more efficient and effective purchasing in the firm under investigation. This directs attention to the research question of this paper: "How may information technology (IT) improve the purchasing function of a petroleum logistics supplier especially in the context of Lean procurement". Thus, supply chain information systems have emerged as the core of successful management in supply chains (Denolf et al., 2015). In an increasingly competitive business environment such as the oil and gas industry, the success of a single enterprise depends on its ability to cooperate and integrate. This integration both within and between the firm and its suppliers and other network partners can best be achieved with the use of information systems/technology. Though previous studies have looked at the use of IT in supply chain (e.g. ERP implementations), the extant literature is limited on how best such information systems/technology can efficiently be integrated in business processes such as purchasing coupled with Lean implementation.

Developing the purchasing function is one such contribution to improving the competitiveness of petroleum logistics service providers. In this study, focus is directed at using IT resources. Resource based theory, rooted in the writings of Penrose (1959), suggests that purchasing and supply chain management will often have the attributes that can enable them to be sources of sustained competitive advantage (Barney, 2012, p. 3). Developing the purchasing function of firms in the petroleum business may involve a range of approaches. In this study we apply a narrative case study of the purchasing function that include detailed

event descriptions from the studied offshore drilling service firm. This description includes features of interaction and information exchange, as well as information system (IS) use. An analytical frame of reference is developed that encompasses the basic resource-based view of the firm that is taken. This is followed by considerations regarding purchasing and information use. Then the challenges regarding the dynamics of service and interaction in a business relationship context are considered. Finally, based on these discussions a research model is developed on IT-enabled purchasing development. In the analysis we apply this model and the frame of reference to point out directions for IT-enabled purchasing development associated with this specific case.

2 Frame of reference

The frame of reference involves two sections. The first describes purchasing and information use and provides considerations regarding the business function under investigation. This is followed by a discussion regarding the resource based view and supply chain management as a research approach for studying how information may support information use in the firm under investigation.

2.1 Business function: Purchasing & information use

The growing importance of supply chain management (SCM) has led to an increasing recognition of the strategic role of purchasing (Anderson and Rask, 2003). Ellram and Carr (1994) state that it has evolved from a mere buying function into a strategic function, and has recently been recognized as a critical driving force in the strategic management of supply chains (Paulraj et al., 2006). Even though it seems clear that the purchasing function's contribution to a company is high and that the strategic importance is not debated, this transformation is progressing slowly (Cousins et al., 2006). Schneider and Wallenburg (2013) state that the purchasing strategy and purchasing organization need to be aligned with a company's overall strategy for purchasing to fulfil both functional and corporate objectives. "Procurement" is a term used to describe purchasing from a wider and more strategic perspective than purchasing. It directs focus to acquisition needs, immediate as well as from a long-term perspective. Van Weele (2010) defines procurement as; "...includes all activities required in order to get the product from the supplier to its final destination. It encompasses the purchasing function, stores, traffic and transportation, incoming inspection, and quality control and assurance, allowing companies to make supplier selection decisions based on total cost of ownership (TCO), rather than price". This definition states that purchasing is a part of procurement. Purchasing can be defined as "The management of the company's external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities is secured at the most favorable conditions" (Van Weele, 2010, p. 8). This brings to mind the important role of purchasing and supply chain management capabilities in achieving competitive advantage for the firm.

According to Cousins and Speckman (2003), the purchasing function is increasingly seen as a dynamic, high profile job with a professional career path, which means that the view of purchasing as a service department performing standard "secretarial" functions is changing. Paulraj, et al. (2006) suggest, based on empirical findings, that to achieve better integration of cross-organizational teams, the purchasing function needs to be included at the highest strategic level. This is in contradiction with reality in many firms, where it is not unusual to see the purchasing department included in the process at a very late stage, usually when purchase orders are being cut. Gadde et al. (2010) point out that purchasing involves variation purchasing

in business relationships characterized as keeping an arms-length to closer ties that are continuously developed. In addition, these authors (Gadde et al. 2010) point out that the number of suppliers may vary. According to Gadde et al. (2010), developing business relationships develops trust and thereby reduces uncertainty and transactions costs associated with purchasing. Their point is that even in cases of leverage products, where it is easy to switch between suppliers, holding on to a single supplier will provide cost efficiencies through enhanced purchasing routines. In cases of strategic purchasing, sourcing is normally a key feature of such purchases. However, through developing business relationships this increases the efficiency of sourcing. Therefore, given the inter-organizational character of purchasing, networking is crucial for achieving efficient purchasing (Gadde et al. 2010).

Information use in purchasing involves using this resource in a business relationship context. Taking into consideration Kraljic's purchasing portfolio (1983) matrix, the design of this information flow necessarily varies. In cases of simpler leverage-type products, the business relationship administering flows of repeated and simple service provision should seek to design an automated solution that is incrementally and continuously improved. In cases of "routine products", information supports relatively routine manual decision-making by a key-account manager and some degree of automation may be necessary. In addition, the borderline between manual and automated information transformation should be determined, and this borderline may change due to variation in human knowledge as well as technology regarding both information systems as well as the service provided. Bottleneck products are challenging products that given the nature of the service supplied should not be that challenging. In these cases, the information flow is largely manual and information systems must support relatively complex decision-making. This implies more challenging purchasing planning. Strategic purchasing is similar to bottleneck product purchasing since they also involve complex manual decision-making. These purchases are however, to a lesser degree recurring and therefore project type processes. This information flow is complex and dynamic with information gradually unfolding over time that is highly path-dependent; one decision affects the next, as the purchasing process unfolds over time. Purchasing, when strategic as well as being associated with bottleneck service, is non-routine. Agility is therefore a key feature of strategic bottleneck purchasing meaning the information system should represent a flexible resource in these cases.

Viewing the complexity of the business processes in such a case, Wang, Rutle and MacCaull (2012, 2013) argue that recent development of the so-called Model-Driven Development (MDD) technology from the IT community provides an applicable approach to developing an adaptive and effective information system that can tackle purchasing associated interdependencies as demonstrated by our case analysis. After describing purchasing, the next stage will be to apply MDD technology to improving the efficiency of purchasing in the firm under investigation and its supplier relationships. Diagrammatic business modeling facilitates involvement of domain experts and business professionals in the development of IT systems, popular modeling languages include Business Process Model and Notation (BPMN) and Business Process Execution Language (BPEL). MDD goes one step further by enabling the (automatic) generation of IT systems from well-defined (mathematically sound) diagrammatic business processes models including purchasing. An important benefit of mathematically interpretable models is that software tools could automatically verify them. In other words, required properties (features) in the form of mathematically interpretable formula could be verified against the business model, so it can be ensured that the model satisfies certain features. This is extremely helpful when the business model becomes too complicated for human identification of defects in the model. One important note is that MDD is still relatively new in industrial applications, so we recommend a thorough review of existing solutions and case studies in

practice. A firm's purchasing function normally covers all these forms of purchasing, and information systems should accordingly be developed, taking into account the complexity involved with variation in types of purchasing. It is, however a challenge to find ways to standardize components of the information system so that a single information system may become flexible enough to handle all these types of purchasing needs.

2.2 Approach: The resource-based view & SCM

Resource-based theory is mainly associated with strategic management literature. Its origins are traced to Penrose's book "Theory of the growth of the firm" (1959). The fundamental assumption of resource-based theory is that resource types are heterogeneous. This differentiates this approach from neoclassical economic theory that assumes resources to be fundamentally homogeneous (Hunt 2000, p. 75). Resources are classified as both physical and human types (Penrose 1959, 24). This implies that knowledge as well as information represents resource types distinct from each other. Resources are varied and separate from each other as well as mobile. Firms are viewed in line with Penrose (1959) as bundles of resources; this bundling is an expression of identity and uniqueness in the marketplace. No firm is a bundle of resources that is exactly the same as another firm. This implies that firms, to varying degrees, are different including firms competing to offer a similar service to customers.

In a supply chain, firms have according to Thompson (1967) different types of resource interdependencies that express the logic of production. Sequentially interdependent are activities that follow one-another, a form of supply chain logic. However, production may also reveal pooled and reciprocal interdependencies. In cases of pooled interdependencies, firms produce through combining heterogeneous resources. In cases of reciprocal interdependencies, production is dependent on knowledge interaction involving information exchange to curb relatively high uncertainty. Sequential interdependencies and pooling resources are associated with complementarity while reciprocal interdependencies involve a search for complementarity between resources in use. According to Richardson (1972) close complementarity is an expression of customer-supplier integration following the line of supply as a chain of production events. This indicates potential for "value co-creation" to increase market competitiveness (Prahalad and Ramaswamy 2000).

Supply chain management (SCM) is founded on systems dynamics thinking from the 1950s (Forrester, 1958) that has from its origins in business consultancy in the early 1980-ies into an academic cross-disciplinary field involving among others time-based competition, process-oriented organizational thinking, lean production, agility focus, resource-based views and virtual organizations (Johanessen and Solem, 2007, p. 265). SCM is a management philosophy that fundamentally concerns integrating at the micro level resource use through activities. At the organizational level, this involves improving complementarities between firms through developing integration in business relationships. SCM is a strategically oriented managerial discipline and therefore seeks normative solutions to help managers integrate operations within and between firms. SCM is accordingly associated with all business processes and not merely the logistical ones (Lambert and Cooper, 2000). From a resource-based view, integration is associated with pooling a firm's resources. The supply chain implies predominately-sequential interdependencies typically found (in line with Thompson (1967)) in goods supply. In services, Thompson (1967) as well as Stabell and Fjeldstad (1998), point to the heightened importance of pooling resources and developing reciprocal interdependencies. Taking a resource-based view, services supply is accordingly

fundamentally different from goods supply based on how heterogeneous resources are combined and used within and between firms.

In a supply network of conglomerate interdependent firms, management is involved in creating firm identity to communicate complementarities through business relationships. The expression of complementarity communicates why one firm needs the other, either performing the role as purchaser or marketer. In line with Penrose (1959), this role of the firm is that which is impacted by internal resource features of the individual firm as well as by its supply network context. The supply chain role of a firm is strongly associated with its interlinkages with other firms, which again affects the type of supply chain role the firm performs, and thereby its competitive strength. SCM is associated with managing interlinkages within and between firms. The resource-based view of the firm, together with interdependency theory, provides explanatory power regarding reasoning for interaction in a supply network. This includes understanding how information as resource glues the company and supply chain together in a "bundle of resources". In the supply chain, efficiencies are sought through evoking resource complementarities between firms understood as heterogeneous bundles of resources. The more similar firms are, the greater the potential for an adversarial network relationship (Gadde et al. 2010). Information is one type of resource in these bundles. Therefore, integration is a search for interconnection of resource heterogeneity through pooling, timing and communication to combine heterogeneous resources. Information is postulated as the gluing type resource that binds these bundles. In business relationships, the mission is to interconnect divergent firms, searching for efficiencies in resource integration to provide effective production and a satisfied customer. In this network setting, information is accordingly a key resource associated with supply chain integration in connecting firms to harness and develop complementarities. Purchasing is a boundary spanning function and information is a vital facilitator of this boundary spanning function.

3 Method

This is a single case study of the purchasing function of a logistics service provider in the offshore petroleum logistics industry. According to Voss et al. (2002), the results of case-study research can have a very high impact leading to the development of new theory as well as high validity among practitioners. This involves developing grounded theory (Glaser and Straus, 1967; Eisenhardt 1989) with potential for theoretical generalization (Meredith 1998). Case research according to McCutcheon and Meredith (1993) both builds on theory and is an excellent tool for developing new theory. In this case, we are concerned with achieving new grounded insight in combining Lean with purchasing. In accordance with Voss et al. (2002), we seek theory extension and refinement. The preceding parts have examined existing literature on both purchasing and lean and we find it pertinent to combine these two constructs, and include a theory based discussion regarding this combination. What is still lacking is the generation of empirical evidence that may ground these considerations. Case-study research provides value in this methodological setting by not only grounding these considerations, but also contributes to refining them. Since the research is questioning "how" to combine Lean and purchasing, according to Yin (2014), the most appropriate choice of research strategy when asking 'how' is the case study.

The company was following a Lean process development procedure, and this is accounted for in the following case description. This implies that Lean thinking is here considered as an empirical phenomenon. Lean is predominately an operational procedure, and this study considers strategic aspects of IT enabled process development at a strategic level based on descriptions of purchasing operations - a "bottom-up"

perspective. Observation plays an important role in creating the case narrative used in this study. This is because one of the authors works in the firm under investigation in this study. Thus, these narratives are therefore partly based on one of the researcher's work experience. Data includes a formalized audit within the firm conducted by two different consultancy firms. This involves an audit report, but also interactions during the audit in the form of meetings and communication with the consultants. An audit of the purchasing function was performed in December 2012 and findings from this process contributed to a third data source: a technical seminar held at the firm. The audit revealed shortcomings in how the purchasing was performed and the possible implications this could have for the quality and money spent on materials. The agenda headline for the seminar was "How do we perform purchases in the firm" and the goal for the seminar was to identify how the process was perceived ("as-is") and how it should be. An external consulting firm on behalf of the petroleum logistics firm under investigation collected the data and findings in order to maintain objectivity. Another source of data used is a report from a seminar associated with developing the company's purchasing function. This report culminated in an extensive cooperation between consultants (other than those performing the afore-mentioned audit) and the firm in developing the enterprise including its purchasing function. This cooperation consisted of bi-weekly meetings. For us, in order to be able to develop this model, another source of data was needed; informal conversation with the end-users. The end-users were the buyers and the representatives from the technical department. Finally, observations include the use of the SAP Materials Management system. SAP is used for all transactions in the purchasing function and data extracted from this provides valuable information when it comes to interpretation of what role the purchasing function in the company has including registering types of purchases that have been performed.

4 Modelling the Purchasing Function of an Offshore Rig Operator

The case text is divided into two parts, first an overview of the purchasing function including its process in the offshore rig operator. This is followed by three brief narratives of real purchasing events, describing both the problems and challenges encountered. This is a simpler process than that applied in IT-enabled process development, but sufficient when considering the role of IT enabled process development in relation to the purchasing procedure being studied, given the limitations of the strategic perspective we have taken.

4.1 The Purchasing function and processes

The purchasing process of the offshore rig operator includes different purchase categories:

- *Capital Equipment*: Installed on an oil rig and with a planned maintenance program. This equipment has a lifetime longer than three years (when in use) and is subject to maintenance procedures.
- *Spare Parts*: Parts used in maintenance thereby satisfying operational assets and equipment requirements.
- *Consumables*: Materials that do not demand systematic control and that are bought through standard long-term contracts.
- *Services*: A typical service is linked to the aftermarket via servicing of components, maintenance on structure and/or rental of personnel.
- *Repair and Rental*: Repair of equipment in maintenance not subject to purchase.

SAP is the applied materials management system in the firm. This is an “off-the-shelf-built-in” purchasing software. The routine purchasing flow for *spare parts* purchase is modelled in Figure 1:

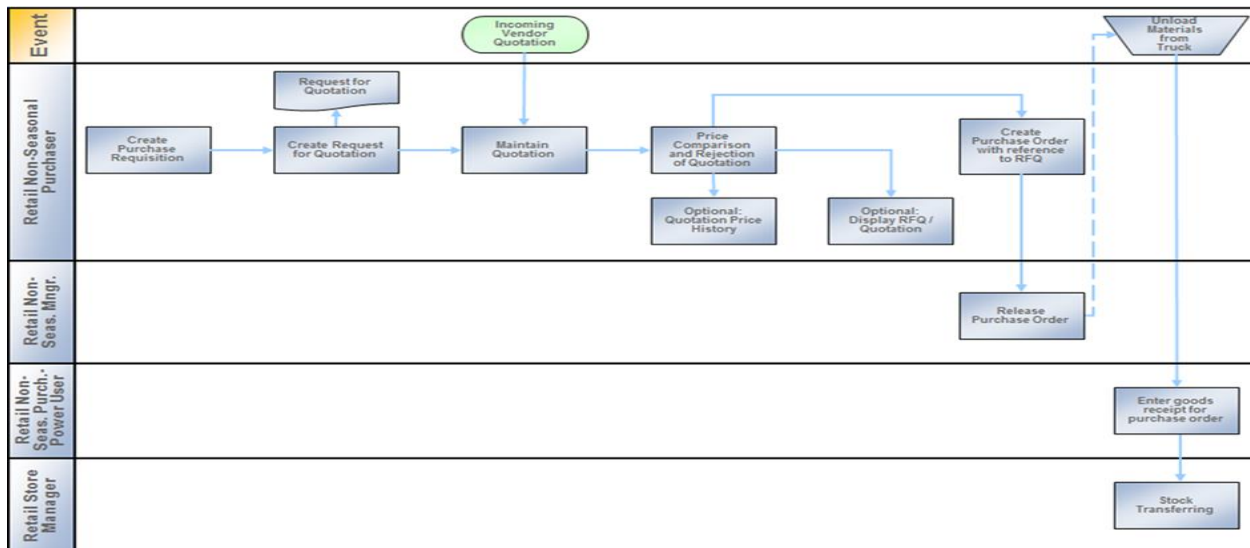


Figure 1. Routine spare parts purchase flow.

The firm has built up a market reputation for promptly paying their bills and has rarely had disputes with vendors. These routine purchases therefore go smoothly. The demand/need for a material or service occurs on the rig. The Rig Team has 3-5 meetings with employees on the rig every week, and the specific demands are part of the agenda. The firm has a substantial amount of purchasing that is not classified as investment. The purchaser is expected to perform these types of purchases, but in many cases other members of the rig team do most of the activities involved in purchasing such as locating suppliers, defining scope, receiving quotes and assessing the offers. They locate suppliers and perform quality assessment of the offers. This means that these categories of purchases are based on experience - a “we have always used them” and “I know him, so they are good” mentality. Buyers possess substantial knowledge of the market and keep a track record of the different vendors. This knowledge is not associated with automated systems and therefore is limited in scope to individual teams working on different rigs. The firm therefore runs a risk of choosing a vendor that does not deliver the best quality at the best possible price when another rig carries out a similar purchase. Still, some formal procedures are followed to secure purchase quality, such as asking for quotations from at least three vendors for all purchases valued at more than 5,000 USD.

The purchase order (PO), the contract with the vendor regulating every aspect of the purchase, is sent to the vendor. It usually contains a vague technical specification and some standard commercial terms. This can of course be sufficient in cases when standard materials are to be bought, but when buying manufactured goods and services, the content of the PO has to be more detailed. The obvious reason is that the more complex a purchase is the more detailed and informative a PO needs to be. When, upon receipt, it is realized that the order contained incorrect specifications, the terms stated in the PO regulates possible solutions, for example, rectification, and the company must bear this risk. The company, aware of the problems and challenges it faces in its purchasing activities and operations and the impact this has on its performance, invited a consultancy firm to hold a series of seminars with the employees. These seminars were a sort of ‘information session’ to find out what employees felt were some of the problems, bottlenecks and

challenges that affected the 'smooth-running' of operations in the company and how best these challenges could be resolved to bring about efficiency. The company and its employees acknowledged the impact of these problems and challenges on the overall profitability of the firm. This is because procurement decisions can be complex and of high value and relate to the bottom line or fundamental success of the company. The following describes some of the issues brought up during this seminar. For instance, it was discovered that the work on the implementation process was carried out at the same time as work on the purchasing procedure was executed. Feedback from the seminar showed that there was no uniform perception of how the process was supposed to be and what support the purchasing function could provide. Most operators believed that they could perform the purchase themselves and that the buyers only purchased spare parts for stock. It was a common belief among operators on the platform that if a technician onboard the rig needed a special valve, which needed to be manufactured, they were the ones that were supposed to make agreements with the vendors and make the necessary arrangements. They then believed that the buyers created the PO and sorted out "the rest".

Through the seminar, a perception grew that the purchasing procedure had shortcomings regarding how such processes were understood and purchasing as process had no links to other functional procedures found within the firm; weak internal cross-functional integration was detected. Using an ERP system (SAP) proved a threshold, and in practice was reserved for Purchasing Department use. This represented an operational need for the Purchasing Department. Furthermore, even though purchasing procedures exist, the seminar showed that almost no one used the procedure. When they were asked to state the reasons for this, the clear feedback was the lack of visual processes and the cumbersome setup and mix of information. Another reason stated was the fact that no one saw the reason to use the procedure when no one else in the organization used it. Another finding was that the procedure had references to old purchasing systems and the abbreviation used was inconsistent and not explained. This made it difficult for the buyers to refer to the procedure especially when users did not act in accordance with the correct process.

The company's strategic goal was to develop an implementation process that merged purchasing with operations. The aim was to do things right the first time and since many people are involved in the process, there was the need for synergy. The purchasing functions therefore have an important role in defining what the purchasing process should look like. Representatives from the external consulting firm, who were hired held bi-weekly administrative meetings with the company's procurement personnel where findings from earlier interviews and issues concerning purchasing and operational matters were discussed. The recurring issue was the buyers influence on the purchase and their role in the purchasing process. None of them felt that their competence was used in the best possible way and that they too often were included too late in the process, especially when the purchase included more than a standard spare part. The feedback from the buyers was that they had no real influence on the content of the PO or in negotiations with the vendors. Also, the quality of the input, which in most cases was given by mail, was vague and did not include information regarding documentation, payment terms, delivery terms or "rebuy clauses". This finding was consistent in an audit later performed by another consultancy firm in 2012. They found that the quality of the purchase requisition was poor and that the risk for an incorrect purchase was imminent. In addition to this, this inquiry revealed that the isolation of duties following functional borderlines was fuzzy. This demanded a clear functional organization in the form of a split between creation of requisition, creation of PO, receipt of goods and invoice handling in SAP. The purchasing flow was shown to be organized in an extremely piecemeal fashion. The purchase requisition was created for goods purchased for stock, but for all the other purchases, no requisition other than a mail formed the basis for the PO. In some cases, the

buyer created requisitions, PO and even produced goods receipts. This hampered internal integration as well as a seamless information flow with suppliers. The feedback from interviews with buyers and the internal audit formed the basis for how the purchasing process should look and where the buyers were expected to contribute in the implementation process. This work led to a purchasing process visualizing the different steps and actions within the purchasing function. The purchase process involves steps from “creation of requisition” until and including “goods receipt/follow-up”. Based on this, an improved purchasing process was developed and this is illustrated in Figure 2:

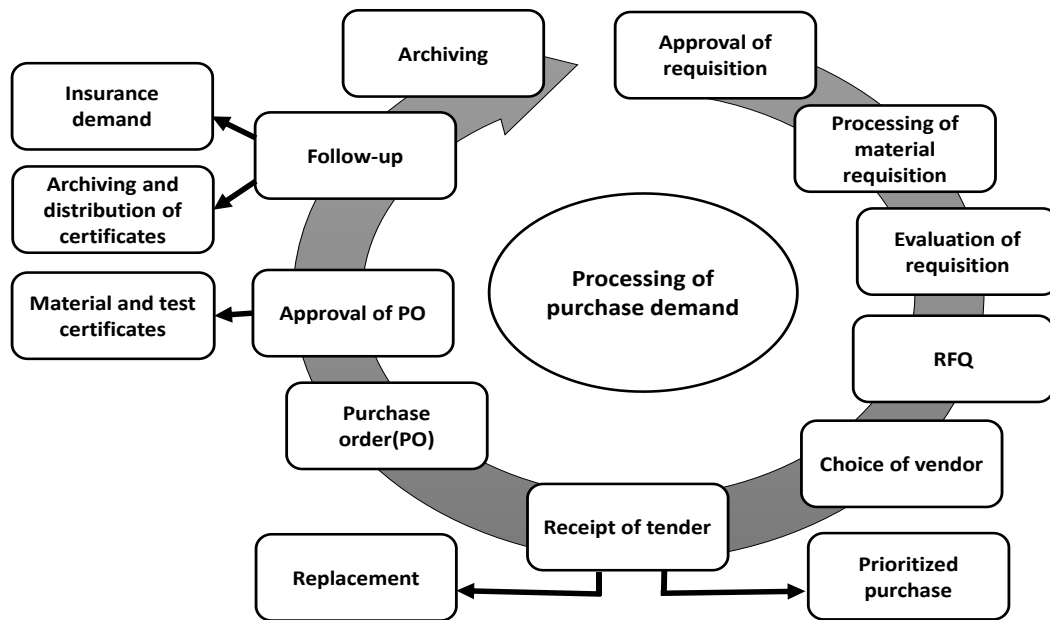


Figure 2. The improved purchasing process

The process is illustrated using a wheel diagram since this better illustrates a notion of continuous improvement. The company has included Lean thinking in its purchasing function development, and this notion is central to "Lean thinking". The now, more "Lean" purchasing process cannot be seen in isolation, but together with the implementation process.

The implementation process includes not only the modelling of the process, but also considers 1) who (role/position) is executing the action, 2) what is to be executed and how, and 3) which system the work process is executed in. This is not accounted for in Fig. 2. The updated procedure was provided as a draft of the purchasing function at the start of January 2013, at the same time as implementation of the implementation process. The company had not yet approved these at the time of the inquiry. Even though the processes have been developed, there has not yet been a change in the organization of the purchasing function. Signals coming from the management level indicate the possibility of restructuring with Purchasing and the Technical Department being positioned directly below the CEO. The argument for this is that operation and support functions need to be separated in order to achieve a more objective view of the different priorities. Since the focal company is a part of a global corporation, the CEO has to consider the impact of the different actions in the focal company on other operations within the same firm. When Purchasing and Technical Department report to the Operations Manager, it is the operations in Norway that is involved and not the global aspect of operations. Furthermore, the building of network teams across

countries is being prioritized and the focus is on achieving synergies, both financially and in quality. The creation of common purchasing procedures and processes is a stated goal in order to do things in a similar way on a global scale, as far as this is possible.

4.2 Three examples of purchasing challenges

The first example is the purchase of a spindle for the main shaft with a value of 485,000 NOK. The rig needed a spindle and contacted the technical department onshore. That department contacted a manufacturer, whom they already knew, and asked for a quote based on drawings registered in the system. The spindle was also registered in SAP but the master data did not contain sufficient data about this and lacked vital information such as, measure and pressure and heat tolerance. It did contain a manufacturer part number and this should have given the vendor sufficient data. What they did not know was that the drawings for the top drive were outdated and therefore the demand for the spindle had changed making the information in SAP valueless.

The technical representative received the quote and sent an e-mail to one of the company's buyer, asking for a PO. The input to the buyer was an e-mail with a reference to the quote, price, manufacturer, point of contact and a SAP-number (what to buy). According to accepted procedures, three other vendors should have quoted for this purchase. Occasionally this can be avoided if the item has to be bought at the OEM (Original Equipment Manufacturer), but that was not the case. This, however, was not the worst infringement. When the goods were received, they were shipped to the rig for assembly. It turned out that the spindle did not fit and it had to be sent onshore for return to the vendor. When the spindle was received onshore, it turned out that the possibility for return of that specific part was not possible. The reason stated by the manufacturer was that since this was manufactured especially for this delivery, it could not be returned. The Purchasing Manager investigated the PO and discovered that it did not state terms of return or buy-back clauses. If not stated in the quote, the vendor will never agree to a return of the materials. This could have been avoided if the drawings had been updated and the master data in SAP had been subsequently updated based on these, and if the technician had known how the commercial side of the business worked. The time and money spent on the purchase, the time spent on trying to sell it back to the vendor as well as the incorrect use of resources together with the fact that the rig had to wait for a new part, can be seen as purchasing process inefficiency.

The second example concerns modification of a heli-fuel facility. Onboard one of the rigs a new heli-fuel facility was required within the year. The assumption was that the facilities available on the market were similar to those of the existing facility and that a replica could be ordered. The technical representative onshore obtained the specification for the old facility and based on this, he contacted a potential vendor. The company created the PO with the commercial terms and conditions. The content of the PO was sufficiently detailed and the technical specifications were accurate. After manufacturing, the equipment was sent to the purchasing company's onshore warehouse for storing until it was to be assembled. Six months later, the heli-fuel facility was still in stock and no plan for assembly had been made. The Technical Manager, who was newly employed, started to ask questions regarding the scope of the assembly work. The feedback said that a detailed scope of the work was not needed since this was a simple replacement and that the personnel onboard were able to perform the work. A technical representative was sent from the Technical Department onboard the rig to speed up the process. He found that the measurements of the new facility were different from the old and that the facility had to be turned 180 degrees to fit. This meant that

the fire hydrants and the beacon had to be moved, new cable trays had to be created, 10-15 drawings had to be updated and a new maintenance plan had to be created. Originally, the personnel onboard were responsible for assembling the new facility, but due to the massive change of scope, the work had to be done by an external service company. The new scope was created and because of the complexity of the task, the vendor that manufactured the facility had to send personnel to carry out the replacement, a second company created the cable trays and a third company were responsible for moving the beacon and fire hydrants. From starting as a fairly simple straightforward project it turned out to be very costly and time consuming. Not only did it cost more, but a lot of personnel onshore had to do extra work because someone had taken shortcuts in the planning and left important personnel out of the loop. This specific case was one of the reasons why the work on the previously described "implementation process" was initiated.

The third example concerns service personnel hire. The personnel are used onboard the rigs. All rigs are certified by DNV for a period of five years or sometimes less. Maintenance on equipment must be controlled by DNV or a DNV accredited company. If the maintenance is not done in accordance with DNV standards and the documentation not updated accordingly, the equipment cannot be used. One of the rigs was carrying out modification on some of its pumps in order to increase its capacity. The scope was fairly small and had been done before. The technical leader wrote the scope and contacted the vendor used on similar jobs. They replied with a quote and added all necessary information regarding man-hours, mobilization/demobilization costs, documentation and the spare parts required. The technical lead sent this to the buyer and asked for a creation of PO based on the quote. The service personnel carried out their job on time and on budget and they delivered the necessary documentation. When the project manager carried out a check on the documentation, he realized that the company had lost their DNV accreditation and could no longer certify equipment on behalf of DNV. The vendor replied that they were in the process of renewing the certificate but had been delayed because of some internal issues. This information was not easy to control by the rig company and requires a vendor management program that tracks these eventualities.

5 Analysis and discussion

The case illustrates a situations where the integration of purchasing, supply chain management and IT enabled process development are confronted with challenges and problems and where proper use is required to achieve improved efficiency. This is an "as-is" scenario, providing a thick description of the administrative workings of the purchasing function of a service provider in the petroleum industry. The first part describes routine purchasing operations, and thereby provides a basis for showing how these purchasing processes may easily be modelled and standardized. However, the following three purchasing narratives reveal that the workings of the purchasing function are far from routine. The entire industry associated with petroleum logistics is prone to a high degree of uncertainty. This is indeed a challenge when considering enterprise modelling of the processes. How can the uncertainty associated with purchasing be process modelled?

Purchasing and supply chain management is necessarily considered as a strategic resource which gives a firm its competitive advantage (Barney, 2012) since it creates value, which is difficult and costly to imitate as well as having no substitutes (Barney 1991). To handle the uncertainty embedded in the firm's purchasing function, resources must be flexible in order to attain the necessary agility within the firm itself as well as in the supply network. Purchasing is important to the firm and it is a strategic tool vital for the efficient and effective provision of its services to its customers. The expertise and capability of the

purchasing function within the firm needs to be a strategically functional resource supporting an agile service supply. This implies both use of heterogeneous pooled purchasing resources as well as developing how people interact to pool these resources. In line with Thompson (1967) and Stabell and Fjeldstad (1998) the importance of addressing strategically pooled as well as reciprocal interdependencies in the purchasing function emerges. Through the case, it is difficult to see whether one of these interdependencies is dominant in a purchasing scenario where people interaction as well as information exchange are seemingly equally vital to achieve purchasing efficiency and effectiveness. Information is a vital resource in supporting this; pooling people and their knowledge as well as facilitating how they exchange information. Again, following Thompson's (1967) fundamentals of his interdependency theory, it is the reciprocal and pooled resource interdependencies that should strategically be focused on, and information systems represent the resource that facilitates this endeavor. The relational synergies, based on developing how resources and activities are interdependent to harness the advantages in the use of such resources, can be problematic due to organizational and network challenges. The oil and gas industry is noted for mega-projects characterized by complexity involving a myriad of contractors, sub-contractors and other actors and stakeholders in a series of highly complex and interlinked relationships. In such a situation, the management of inter/intra-organizational relationships is of utmost importance. The information flow between those who make requisitions, users and purchasing departments between the firm and its vendors require special relationship management. Between the firm and its vendors, transaction cost (Williamson, 1991) perspectives prescribe relationship governance in terms of formal contracting while alternatively relationship governance can be described in terms of norms or trust-based mechanisms termed relational contracting (Macneil, 1980).

Firms can achieve efficiency and effectiveness by use of systems. Information systems are useful to collect, process, store and distribute information. IT-based information systems enable efficient operations and effective management in organizations. In this case, this is associated with purchasing process development directed towards enabling the effective service of this function within the firm to attain the necessary agility. Thus, an information system is a socio-technical system comprised of a technical sub-system and a social sub-system. The technical sub-system encompasses the technology and process components while the social system encompasses the people and the structure components (Piccoli and Liu, 2007). The interaction between the four components (process, people, structure and technology) has an impact on the extent that such systems can be used to achieve efficiency. IT-enabled process development, through the use of information systems could help the firm to attain the necessary agility. Since humans are clearly a very flexible use, developing the purchasing system of the firm must enhance the use of the human knowledge resource. This must also consider how information may support human decision-making based on knowledge. This indicates also, that the case studied can become more efficient by way of reducing costs through a reduction in excess inventory or by eliminating costly mistakes that may occur in purchasing operations. Better communication and coordination including how people interact, is better achieved when information is shared so that different individuals, in different departments or different organizations in the supply chain can achieve a common goal and design IS through MDD to support the purchaser in this unruly functionally-determined purchasing context.

6 Conclusion

Companies in industries such as oil and gas, confronted with an ever-changing business environment can leverage their activities and better utilize their resources if they pay much attention to purchasing. The study points out how purchasing is embedded in uncertainty. SCM provides guidance regarding the importance

of cross-functional integration, as well as integration between firms. At a micro-level of process integration, the resource-based view provides guidance in creating and understanding of how heterogeneous resources are combined to create value; how process may be integrated using different types of resources from a purchasing functional/process perspective. Analysis suggests putting the purchaser in focus. The information system plays the role of a supporting resource. IT is an enabler in this improvement: dependent on close interaction with other competence areas, among them importantly SCM and purchasing. This evokes the importance of cross-functional thinking in IT-enabled process development, heightened in cases of uncertainty in the supply chain. This development is envisioned as incremental and continuous, occasionally involving steps of radical innovation. This study used a single company in the oil and gas industry in Norway as its empirical case analysis. Though findings may not be generalized, it may be possible to transfer some general statements from this study across other industries. Further research is called for in using MDD to enable modeling the uncertainty typical of the purchasing processes found in this case study. This implies a form of action research as the preferred approach.

References

- Anderson, P.H., and Rask, M. (2003), "Supply Chain Management: new organizational practices for changing procurement realities". *Journal of Purchasing and Supply Management*, Vol. 9, issue 2, pp. 83-95.
- Barney, J. B. (2012), Purchasing, supply chain management and sustained competitive advantage: The relevance of resource-based theory. *Journal of Supply Chain Management*, Vol. 48, issue, pp. 3-6.
- Barney, J. (1991), "Firm resources and sustained competitive advantage". *Journal of Management*, Vol. 17, issue 1, 99-120.
- Cousins, P.D., and Speckman, R. (2003), "Strategic supply and the management of inter-and intra-organizational relationships". *Journal of Purchasing and Supply Management*, Vol. 9, issue 1, pp.19-29.
- Cousins, P.D., Handfield, R.B., Lawson, B. and Petersen, K.J. (2006), "Creating supply chain relational capital: The impact of formal and informal socialization processes", *Journal of Operations Management*, Vol. 24, No. 6, pp. 851-863.
- Denolf, J. M., Trienekens, J. H., Wognum, P. M., van der Vorst, J. G. A. J. and Omta, S. W. F. (2015), "Towards a framework of critical success factors for implementing supply chain information systems", *Computers in Industry*, Vol.68, pp.16-26.
- Eisenhardt, K.M. (1989), "Building Theories from Case Study Research", *Academy of Management Review*, Vol. 14, No. 4, pp. 532-550.
- Ellram, L.M., and Carr, A. (1994), "Strategic purchasing: A history and review of the literature", *International Journal of Purchasing and Materials Management*, Vol. 30, issue 2, pp.10-18.
- Forrester, J.W. (1958). "Industrial Dynamics: A Major Breakthrough for Decision makers". *Harvard Business Review*, Vol. 36, issue 4, pp. 37-66.
- Gadde, L.-E., Håkansson, H. and Persson, J. (2010), *Supply Network Strategies*, Chippenham UK, Wiley.
- Glaser, B. G. and Straus, A. L. (1967). *The discovery of grounded theory: strategies for qualitative research*, Chicago; Aldine.
- Hunt, S. (2000), *A General Theory of Competition*, Thousand Oaks Ca., Sage.
- Johanessen, S.O. and Solem, O. (2007), *Logistikkorganisasjoner*, Oslo, Gyldendal.

- Kraljic, P. (1983), "Purchasing must become Supply Management". *Harvard Business Review* September-October, pp. 109-117.
- Lambert, D. M., and Cooper, M. C. (2000), "Issues in supply chain management". *Industrial Marketing Management*, Vol. 29, issue 1, pp. 65-83.
- Macneil, I. R. (1980), *The New Social Contract*, Yale University Press; New Haven.
- Meredith, J. (1998), "Building operations management theory through case and field research", *Journal of Operations Management*, Vol. 16, No. 4, pp. 441-54.
- Penrose, E. (1995), *The Theory of the Growth of the Firm*. Oxford UK: Oxford University Press; Reprint with new forward of the original version from 1959.
- Paulraj, A., Chen Injazz, J. and Flynn, J. (2006), "Levels of strategic purchasing: Impact on supply integration and performance", *Journal of Purchasing and Supply Management*, Vol. 12, issue 3, pp. 107-122.
- Piccoli G. and Liu, i. (2007), Achieving efficiency and effectiveness through systems, in Watson, R. T (ed.) *Information Systems, the Global Text Project*. Available online: http://www.uky.edu/~gmswan3/777/IS_Book.pdf, accessed 29.06.2015.
- Prahalad, C.K and Ramaswamy, V. (2000), "Co-opting customer competence". *Harvard Business Review*, Vol. 78 (January-February), pp. 79-87.
- Richardson, G.B. (1972), "The Organization of Industry". *The Economic Journal*, September, pp. 883-896.
- Rutle, A., Wang, H. and MacCaull, W. (2013), "A Formal Diagrammatic Approach to Compensable Workflow Modelling". *Lecture Notes in Comput. Sci.*, Springer-Verlag, 2013, 7789:194-212.
- Schneider, L. and Wallenburg, C.M. (2013), "50 Years of research on organizing the purchasing function: Do we need any more?", *Journal of Purchasing and Supply Management*, Vol. 19, issue 3, pp. 144-164.
- Stabell, C. B., and Fjeldstad, Ø. D. (1998), "configuring value for competitive advantage: on chains, shops, and networks". *Strategic Management Journal*, Vol. 19, issue 5, pp. 413-437.
- Thompson, J.D. (1967). *Organizations in Action*, New York, NY, McGraw Hill.
- Van Weele, A.J. (2010), *Purchasing & supply chain management: analysis, strategy, planning and practice*, Cengage Learning, Andover MA.
- Williamson, O. E. (1991), "Comparative economic organization: the analysis of discrete structural alternatives", *Administrative Science Quarterly*, Vol. 13, issue 6, pp. 667-683.
- Wang, H., Rutle, A. and MacCaull, W. (2012), "A Formal Diagrammatic Approach to Timed Workflow Modelling". *Proceedings of the 6th IEEE International Symposium on Theoretical Aspects of Software Engineering (TASE 2012)*, Beijing, China, IEEE CS, July 2012, pp.167-174.
- Voss, C., Tsikriktsis, N. and Frohlich, M. (2002), "Case Research in Operational Management", *International Journal of Operations & Production Management*, Vol. 22, No. 2, pp. 195-219.
- Yin, R.K. (2014), *Case study research: design and methods*, Sage, Thousand Oaks, CA.