Industrial Service Strategy
Development, Implementation and Execution

Doctoral Thesis by

Rajesh Kumar

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Abstract

Increasingly, as markets become more competitive and globalized, industrial service providers are dependent on effective and efficient service strategies to achieve a certain level of customer satisfaction and to create a win-win situation for the involved parties. This research investigates the development, implementation, and execution of industrial service strategies. Based on four case studies performed in the Norwegian oil and gas industry and Swedish manufacturing and service industry, two frameworks for industrial service strategies are suggested, verified and validated.

The first framework considers the development and negotiation of industrial service contracts. The framework highlights key factors that need to be considered when negotiating industrial service agreements to avoid conflicts and to develop healthy relationships. Planned services can be considered based on product failure predictability. However, successful service providers also need to set up contingency plans for resolving problems caused by unpredictable failure events in an effective and efficient manner.

The second framework considers the development, implementation and execution of industrial service strategies. The research demonstrates that to develop an effective and efficient service strategy one should consider major influencing factors, their attributes and performance factors. Engineering factors/parameters such as reliability and maintainability need to be considered, in addition to non-engineering factors such as the geographical location, operational requirements, operating environments, external factors, etc. In the development, implementation and execution processes, performance factors such as cost drivers, performance killers and critical success factors need to be defined to assess the performance of the service delivery process, the service content, and the service strategy as a whole.

Keywords: Industrial services, service strategy, maintenance and asset management, engineering characteristics, influencing factors and their attributes, performance factors, service contract negotiation, strategy implementation, strategy execution, oil and gas industry.

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Stavanger, Norway

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Paper II Kumar, R. and Kumar, U. (2004), "A conceptual framework for the development of a service delivery strategy for industrial systems and products", *Journal of Business and Industrial Marketing*, Vol. 19 No. 5, pp. 310-319.

Paper III Kumar, R., Markeset, T. and Kumar, U. (2004), "Maintenance of machinery: negotiating service contracts in business-to-business marketing", *International Journal of Service Industry Management*, Vol. 15 No. 4, pp. 400-413.

Paper IV Kumar, R and Markeset, T. (2005), "Development of performance-based service strategies for the O&G industry: a case study", accepted for publication in *Journal of Business and Industrial Marketing*.

Paper V Kumar, R., Markeset, T. and Kumar, U. (2005), "Implementation and execution of industrial service strategy: a case study from the oil and gas industry", accepted for publication in *Journal of Quality in Maintenance Engineering*.

Paper VI Markeset, T. and Kumar, R. (2005), "Cost reduction and performance enhancement through industrial support services – examples from Norwegian industry", submitted for publication in an international journal.

Additional papers, not included

Paper VII Kumar, R., Panesar, S.S. and Markeset, T. (2005), "Strategy development for industrial services and product support", in proceedings of *The First International Conference on Operations and Supply Chain Management*, ISBN 979-545-039-5, December 15-17th, Bali, Indonesia.

Paper VIII Kumar, R. and Markeset, T. (2005), "RCM as a tool to improve production performance – examples from Norwegian industry", in proceedings of *Geominetech Symposium on "New Equipment-New Technology management and Safety" in Mining and Mineral based Industries*, May 11-12th, Bhubaneswar, India.

Paper IX Markeset, T. and Kumar, R. (2004), "Experiences from implementation of Smart OMS to enhance operation and maintenance performance in the Norwegian industry", in proceedings of *Intelligent Maintenance Systems International Conference*, July 15-17th, Arles, France.

Paper X Markeset, T., Kumar, R. and Kumar, U., (2003), "Trends in product support and service delivery strategy for mining industries", in proceedings of *Geominetech Symposium on "New Equipment-New Technology management and Safety" in Mining and Mineral based Industries*, May 11-12th, Bhubaneswar, India.

Part I – Thesis summary

1 Introduction and background

During the past few decades, industrial markets have become more globalized. This change has stimulated international trade and intensified competition as regional companies seek new markets. The introduction of innovative technologies has transformed existing products and brought new ones into the marketplace. The use of advanced and sophisticated technologies has placed greater demands on both manufacturers and product users with respect to product support and services. System/equipment users need the manufacturer's and/or specialist service providers support for the products/systems to assure production availability[1] and smooth operations (see also Blanchard et al., 1995). Patton and Bleuel (2000) describe support as any action to sustain or complement any thing to keep it effective by furnishing it with what ever it needs. Generally, certain levels of support services have always been needed, as the complex, integrated and advanced system is often beyond the capability and/or resources of industrial users.

Industrial customers are increasingly demanding services and integrated solutions when buying a product. They want to buy a product that meets their quality requirements, and is delivered in the right quantity, at the right time, in the right place, from the right source (a vendor who is reliable and will meet commitments in a timely fashion), with the right service (both before and after the sale) and at the right price. The customer is of the opinion that these objectives should occur simultaneously to foster a buying tendency (Belev, 1993; also see Davies, 2003). A service provider's uniqueness and competences differentiate them from competitors and create their reputation and image in the market. Küssel et al. (2000) assert that "*service has a greater influence on the decision to buy a product than the price or even the function has*".

Recently, opportunities for support service providers/solution providers have arisen and advanced and complex technology requires skilled operational and

[1] Availability: The ability of an item to be in a state to perform a required function under given conditions at a given instant of time or during a given time interval, assuming that the required external resources are provided (prEN13306, 1999).

maintenance personnel/service providers. Such technology is most often not maintenance-free, and therefore usually requires spare parts, diagnostic assistance, and other product support. Often such systems employ advanced electronics and control software that need to be upgraded and/or modernized. In addition, services are required for enhancing operational skills and improving product performance (see for example Lele and Karmarker, 1993; Markeset, 2003; Mathieu, 2001a and 2001b; Patton and Bleuel, 2000).

Furthermore, it is observed that the engineering industry is changing dramatically in that product concepts are evolving into solution concepts, as shown in Figure 1 (Kalliokoski et al., 2004). In a solution concept, the customers are becoming more dependent on solution providers' services to utilize the solutions. In a solution concept, the customer is interested in the function that the product performs and the solution to a problem that the combined product and service provides (see also Paper I; Markeset and Kumar, 2005). It seems that Levitt's (1969) contention that the customers are interested in buying holes and not in the drilling machine seems to be being verified. However, the industry is not only in need of services related to products/equipment used in the production processes (e.g. after sales services, product support), but all kinds of services (e.g. special competence services, consulting services, organizational performance services) that can provide solutions to problems and assist them in enhancing performance and to become more competitive (see Goffin, 1999; Markeset, 2003; Mathieu, 2001a; Patton and Bleuel, 2000).

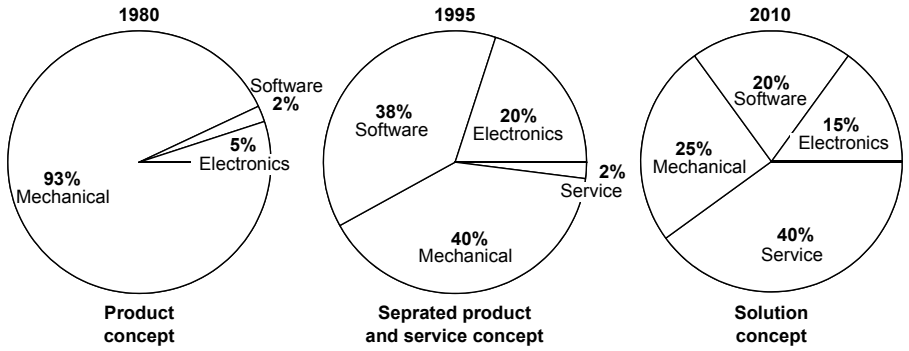

Figure 1 Breakthrough development vision of the mechanical industry (Kalliokoski et al., 2004)

The focus on service is increasing, as customers are increasingly demanding comfortable and reliable services at the lowest possible costs. At the same time, the service providers' intentions are to increase the value for their customers and seek technological developments to facilitate the service creation and service delivery process (see for discussion Grönroos, 2000; Nordin, 2005, Paper VI). Service

represents an important link in the commercialization process. It defines customers' needs and integrates them with appropriate technologies to solve customers' problems (Kuusisto and Meyer, 2003). Service processes increase the interaction between the customer and service provider, which results in more business opportunities and could improve the service quality. When there is excellence in services, customers, employees, management, stockholders, communities, and countries win. Zeithaml et al. (1990) point out that "*Excellence in service pays off as it creates customers who will use the service again and also sing the firm's praises to others*".

ABB is one example of a company which sees performance-based services for industrial markets as a focus area. In a special report, focusing on industrial services the company states that: "*Manufacturers can no longer afford to install equipment and forget about it. Sustainability and return on investment have become fundamental issues. However, years of downsizing and emphasizing core competencies, as well as the pace at which automation and computing technology become obsolete, mean that manufacturers can no longer solely rely on internal staff to meet the demands of designing, implementing and maintaining their automation technology. This shift brings new responsibilities to engineering and automation technology firms. It requires suppliers to take responsibility for the performance of their products and solutions over time, not just at implementation. ABB is committed to this goal with performance-based services that incorporate new and innovative ways to bring value to ABB clients*" (ABB Review, 2004).

For manufacturers/suppliers, services are important because they (Goffin, 1999):

- can be a major source of revenue
- are essential for achieving customer satisfaction
- can provide a competitive advantage and
- play a role in increasing the success rate of new products

However, for a manufacturer to become a service provider is not easy. Research suggests that "*many of the challenges [stem] from the manufacturing-oriented way of doing business*" (Brax, 2005). Often an original equipment manufacturer (OEM) cannot always provide the desired level of service for an entire product line due to constraints such as the geographical location, external factors, the operational environment, cost etc. As an alternative, an OEM may develop a support network and assign responsibility for maintaining the system to an independent local service provider. Although dependent on an independent service provider, progressive OEMs maintain contact with users/customers and obtain reliable and useful feedback about the product performance in the operational phase. The feedback provides a well-structured basis for later modifications and/or design changes (for more detail see Paper I and Paper III).

In business, a customer receives something in exchange for some payment, and this is output of the process. It may be a physical good, an intangible service or some kind of combination of the two (some items tangible and others intangible). Tangible attributes are defined as being perceptible through touch, and these attributes are definite, clearly intelligible and not elusive or visionary. For instance, a customer buys a car and, while buying something tangible (it can be touched, seen and even smelt), is looking for something additional which cannot be seen. Prestige, safety and comfort are examples of intangible aspects, which cannot be touched. Service belongs to the intangible group. In general, services cannot be stored like physical goods due to their perishable character. The production and consumption of services are simultaneous activities due to their inseparability in character. It is more a question of a process or a performance than an object (for more detail see Smith, 1998; Hope and Mühlemann, 1997; Zeithaml and Bitner, 2000). Moreover, Zeithaml and Bitner (2000) assert that "*services are deeds, processes and performances*". Deeds are activities designed to solve problems for customers. Processes are identified approaches used to carry out deeds. Performance relates to service quality and customer satisfaction; i.e. the technical outcome of the service (the quality of the deed, or service content), as well as how well a deed is performed and how it is delivered (process quality, e.g. service process effectiveness and efficiency). Furthermore, Grönroos (2000) divides services in three groups, namely:

1. core services
2. facilitating services (and goods)
3. supporting services (and goods)

The core services create the basis and the reason for a company being in the market. For instance, a service company may provide support for a production facility to improve performance (e.g. HSE performance, operational expenses (OPEX) reduction, and production regularity) and this would constitute its core services. In order to facilitate for customers, to increase availability and support their work processes, the core services require some additional services. Such additional services are called facilitating services, because they facilitate the use of the core services. If the facilitating services are lacking, the core services cannot be consumed. Sometime facilitating goods are also required. For example, most of the consulting companies use special software to enable the core services.

The supporting services are also additional services, but they fulfill another function. Grönroos (2000) points out that "*supporting services do not facilitate the consumption or use of the core services, but are used to increase the value of the services and/or to differentiate the services from those of competitors*". Supporting goods are used to enhance the service provision. For instance, when preparing reports, these should be written clearly using standard ways/formats for defining and explaining the solutions as well as the problems, and the service buyer should be able to understand the reports without any confusion. For an airline company, the

transportation of customers is the core service, airport services are facilitating services, and different types of offers and travel packages are defined as support services that add value for the customer as well as for the airlines.

Companies can use services as a tool to create and facilitate long-term relationships. Paloheimo et al. (2004) emphasize that "*There should be a clearly defined customer relationship strategy and the organizational behavior should be aligned with the strategy, not only on managerial levels but on all levels of the organization.*"

1.1 Relationships

Relationships in business markets are characterized by factors such as trust, commitment and adaptation. In business, relationships provide the basic conditions for developing service quality, and the results of these efforts will have a significant impact upon the customer satisfaction level. Positive relationships lead to customer retention. Better services usually lead to customer satisfaction and longer and healthier relationships. Consequently, transparent and stable relationships are established, which reduces the need for information exchange in service buying processes and makes it possible to exchange confidential information between a service provider and customer (Eriksson et al., 1999, and for discussion and references see Paper III).

Gummesson (1999) underlines the fact that there is invariably a gap between ideas and action. It can be caused by a lack of implementation skills and stamina or, more fundamentally, by difficulties in grasping relationship essentials. Moreover, the fulfillment of promises is a core concept in all relationships. Figure 2 illustrates elements of relationships.

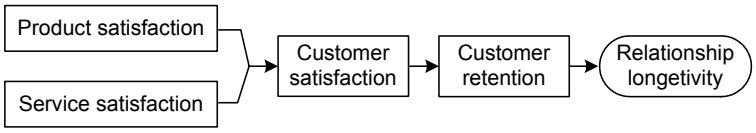

Figure 2 Elements of relationships

Grönroos (2004) asserts that part of the foundation of relationship marketing is the interaction and communication process between the customer and the service provider. Furthermore, he points out, "*In a relationship customer perceived value is developing and perceived over time*".

To create a win-win situation for all the involved parties and to create a healthy long-term relationship, it is necessary to develop an effective service strategy. A

comprehensive service strategy defines which services need to be provided and when and how they are to be provided. Therefore, to provide effective and competitive services, firms must develop a service delivery plan. In the planning process, the firm must consider major factors that will influence the service delivery process and service content, as well as parameters for measuring service delivery performance. Such a plan is most commonly referred to as a *service strategy*.

1.2 Service strategy

A strategy is a comprehensive master plan and it describes "how" an organization will achieve its mission and objectives. The word "strategy" comes from the Greek word "*strategia*", which means the art of war (Chaharbaghi and Willis, 1998). Hope and Mühlemann (1997) expand upon the definition by quoting the Collins English Dictionary (3rd. ed., 1991), which defines strategy as:

- the art and science of planning and conducting a war; generalship
- a long term plan for success, especially in business or politics
- a plan or stratagem

Service strategy can be defined as a plan for achieving the service goals of both the service receiver (buyer) and the service provider (seller). The plan states what services are needed (i.e. the service content and outcome), where they are needed (the location), how they are to be delivered (the service delivery process), when they are to be delivered and how long time they are needed (timing and duration), whom to deliver them to and what resources are needed (personnel, skills, tools, equipment, etc.), and why the services are needed (the reason). The plan should also suggest approaches to fulfilling the defined service requirements to achieve the service goals, and define how to measure or evaluate the service performance. A professional organization develops a short-term or long-term strategy to plan where it wants to go. Without such a strategy, it is easy to get lost and deliver imperfect or wrong services, or deliver services ineffectively or with an unsatisfactory performance (see for further discussion Paper III and IV).

Strategic thinking involves intuition and creativity. Strategies cannot be created by analysis, but analysis gives viable inputs to the development of strategies and helps one to make them operational (Mintzberg, 1994). "*The term 'strategy' means a deliberate, conscious set of guidelines that determine decisions about the future"* (Mintzberg, 1978). In management theory, strategy is typically defined as "*the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary to carry out these goals*" (Chandler, 1962, cited by Mintzberg, 1978). Furthermore, three themes should be considered in strategy formation. The first is that strategy formation can be viewed as the relationship between a dynamic environment and bureaucratic

momentum, with leadership mediating between the two. Secondly, strategy formation over periods appears to follow distinct regularities, which may prove vital to understanding the process. Thirdly, the study of the relationship between intended and realized strategies may lead us to the heart of this complex organizational process (Mintzberg, 1978). Organizations formulate strategies to increase their business profit and their competitiveness in the market (Manarro-Viseras et al., 2005).

1.2.1 Strategy types

In the business world, strategies can be broadly divided into two groups (Hope and Mühlemann, 1997):

- **Organizational strategy:** This group includes corporate strategy, corporate planning, business strategy, business policy, and strategy management. Each concerns some aspect of long-term organizational planning. Corporate strategy concerns the overall operational direction and management, while business strategy emphasizes improving the competitive position of products.
- **Functional strategy:** This group emphasizes maximizing resource productivity. Included are operations, human resources, marketing, finance, information technology, logistics support, operation, maintenance work and other activities appropriate to the organization concerned. Figure 3 illustrates the relationships.

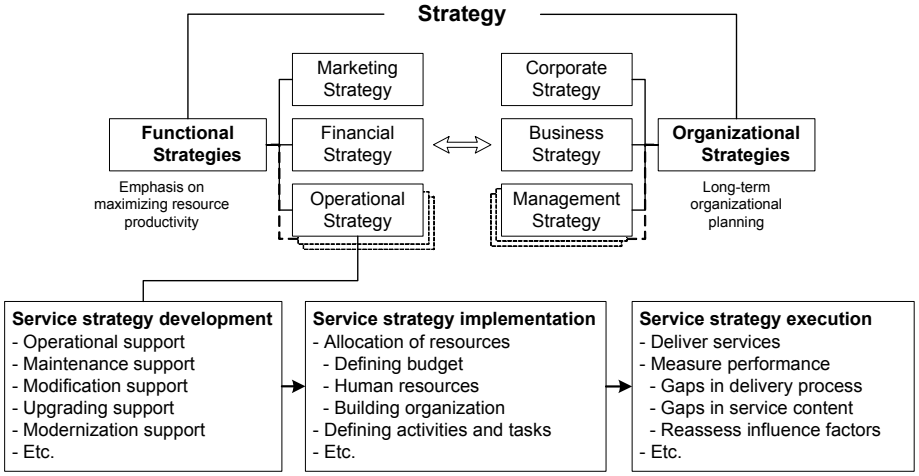

Figure 3 Different approaches to strategy (Paper V)

Strategy comes into play if there is a purpose, the absence of which reduces strategy to a meaningless concept. Without fundamental ideas, there is no context for

strategy formulation, implementation and execution. Proper execution of a strategic planning process represents a natural process that must occur for an organization to achieve desirable outcomes (for discussion see Paper II, IV and V). When considering strategy, it is important to remember that confusion and complexity arise when strategy becomes the end goal rather than the means to an end. Strategy is necessitated by competitive survival and it is used to identify the best way(s) to achieve goals (Chaharbaghi and Willis, 1998). See also Johnson and Scholes (1999) and Slack et al. (2001) for further discussion.

1.3 State of the art

As products are becoming more advanced, complex and integrated, many manufacturers are finding themselves supplying more services to support the product and the customer. These services help customers to understand the product characteristics and draw the optimum performance from the intended function, as well as to learn how to keep the product in its operating state. Additionally, customer support (e.g. training) helps to improve the operator skill and facilitates achieving the highest possible performance faster (for further discussion see Markeset, 2003). There exists a vast body of literature that describes different forms of services often required for consumer products (see e.g. Grönroos, 2000; Grönroos, 1999; Grönroos, 1998; Eriksson et al., 1999; Johns, 1999; Fredericks et al., 1998; Berry et al., 1988; Lele and Karmarkar, 1993; Edvardsson et al., 1994; Zeithaml et al., 1990).

The literature surveys indicate that there is a shortage of literature that deals with services needed for industrial production facilities. We found less literature discussing how to develop an industrial service strategy. The few exceptions focus on industrial services, but pay limited attention to service strategy and factors influencing such services (e.g. maintenance needs, the operating environment, external factors, the geographical location, etc.), their attributes (e.g. for maintenance needs: reliability, maintainability, etc.), and performance factors (cost drivers, performance killers, critical success factors, etc.) (see e.g. Nordin, 2005; Bovik, 2004; Markeset, 2003; Kalliokoski et al., 2004; Andersson, 2002; Goffin, 1999; Smith, 1998; Brentani, 1995; Löfsten, 1999; Malhotra et al., 1994; Morris and Fuller, 1989).

Moreover, there is shortage of literature with respect to service strategy implementation and execution. The few exceptions discuss issues concerning an implementation and execution strategy, and the complexity and importance of having such a strategy, as well as implementation challenges (see e.g. Wery and Waco, 2004; Okumus, 2003; Aaltonen and Ikävalko, 2002; Grundy, 1998; Hiles, 1994; Alexander, 1991; Alexander, 1985). Bigler (2001) asserts, "*It is clear that strategy execution will emerge as one of the critical sources of sustainable advantage in the 21st century*".

For the Norwegian Oil and Gas (O&G) industry, industrial services are becoming increasingly important, and hence a framework and a foundation are needed for systematic development, implementation, execution, and performance assessment in the field of industrial services strategy.

The Norwegian oil and gas industry

In Norway, the Oil and Gas (O&G) industry is contributing a substantial part of the country's GNP (gross national product). It has been observed that industrial services have recently been becoming increasingly important to sustain development and value creation. Operators are increasingly choosing to outsource non-core activities to specialized service companies, and some of these services have been traditionally performed by external companies (e.g. drilling services and well services). It has become essential to create an improved foundation for increasing international competitive strength (OLF, 2003; OG21, 2004).

The O&G industry is gradually stepping into a new stage of development and many of the O&G fields have reached their plateau phase and are now entering their tail-end production phase (NPD Report, 2003; 3i Report, 2004; NPD Report, Facts, 2005). At this stage, it becomes essential to reduce the operational expenses (OPEX) or to raise the production to prolong the economic lifetime and tail-end production phase, as shown in Figure 4. If possible, both alternatives should be explored. The production may be increased by connecting new deposits to existing production facilities or by implementing measures for enhanced O&G recovery from existing deposits (see for example Schulte et al., 1993). However, this is often not feasible. Reducing OPEX is difficult, since a large part of the production facilities, equipment, and machinery is worn and deteriorated, and therefore may have increasing failure rates.

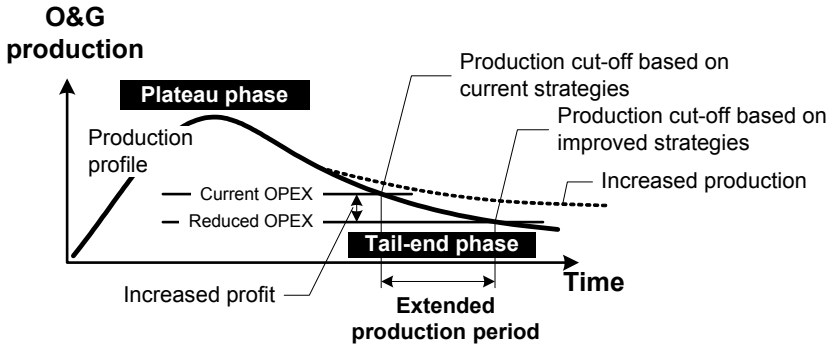

Figure 4 Extension of the production period by reducing operational and maintenance costs (Paper IV)

Moreover, compared to modern technology, some of the production facilities may be ineffective and inefficient, lacking, for example, instrumentation for modern control and condition monitoring. There is considerable potential for further production and value creation through improved product support and service strategy in recovering oil from the reservoirs reducing OPEX (operational expenses) or CAPEX (capital expenses) in the case of modernization (such as modifications and upgrading of existing facilities as an alternative to expensive and risk-prone maintenance of old installations).

1.4 Research questions

More research work has been carried out to define service strategies and delivery processes for consumer products than has been conducted to define the same strategies and processes for industrial products. As industrial products are becoming increasingly advanced, complex and integrated, customers are becoming increasingly dependent on industrial services to support effective and efficient product utilization. Consequently, there is a need for a framework for industrial service strategies, taking into account major influencing factors as well as service strategy implementation and execution and performance assessment. To obtain a holistic view and to understand the importance of industrial services and practices and how to exploit them better, research need to be performed.

Based on the discussion in the previous sections, the following research questions are posed:

- What are the trends in services for industrial products?
- Which influencing factors and their attributes as well as performance factors need to be considered in service strategy development and the delivery process, including strategy implementation and execution?
- How can one exploit the potential of strategic assets like product support, supporting services and their implementation and execution process, to enhance an organization's competitiveness and profitability?
- What are the key contents of service contract development and negotiation process?

1.5 Research scope and objectives

The scope of this Thesis is to develop frameworks for industrial service strategy negotiation, development, implementation and execution in the Norwegian Oil and Gas Industry.

The main objective of this Thesis is to map, study and analyze industrial service strategies, and to suggest frameworks for negotiation, development, implementation and execution of service strategies.

Sub-objectives includes:

- To investigate the goal of a service strategy with respect to minimizing the gap between required and delivered services.
- To examine practices in service strategy in the Norwegian Oil and Gas Industry and suggest improvement measures.
- To examine and analyze factors and attributes as well as performance factors influencing the service strategy.

1.6 Limitations

The research study only focuses on industrial service processes. Service processes related to consumer products are not included. Issues related to supply chain management, logistics, inventory management, and concepts such as customer buying behavior, relationship management, sourcing strategies (e.g. outsourcing and insourcing), partnering, etc. are not within the scope of this Thesis.

Based on the literature surveys and our own knowledge and experiences, it was decided to keep the focus of the research work on industrial services related to product support and technical support for industrial systems during the operation phase. Furthermore, most of the research work is focused on the Norwegian O&G industry, since it is a capital-intensive industry utilizing increasingly advanced and complex products, and is becoming increasingly dependent on industrial services to assure production regularity.

The study does not discuss and take into account the terms, conditions, legal terms and requirements of contracts. However, some of the factors that need to be negotiated in a contract with respect to service strategy to fulfill the contract requirements are discussed since service strategies often depend on the requirements of specific contracts and projects.

2 Research approach and methodology

The main objective of Chapter 2 is to present and discuss the research, methods utilized in the research study. The reason for conducting any research is to find out 'why' things happen as they do (Carey, 1994). Normally, to conduct research one should develop a research strategy. The research strategy should reflect one's research methods, the approach to the research questions, and the research project requirements.

In the research process, the '*preunderstanding*' and '*understanding*' of the project constitute one of the important challenges. '*Preunderstanding*' refers to insights into a specific problem before a research program begins (it is the input to the research process). '*Understanding*' refers to insights gained during a program or assignment (it is the output). This output, in turn, acts as '*preunderstanding*' before the next task. Reliability, validity, objectivity, and relevance help to check the quality of the research work and compare it with the defined research questions (Gummesson, 2000). Figure 5 presents an overview of the research process used in this Thesis.

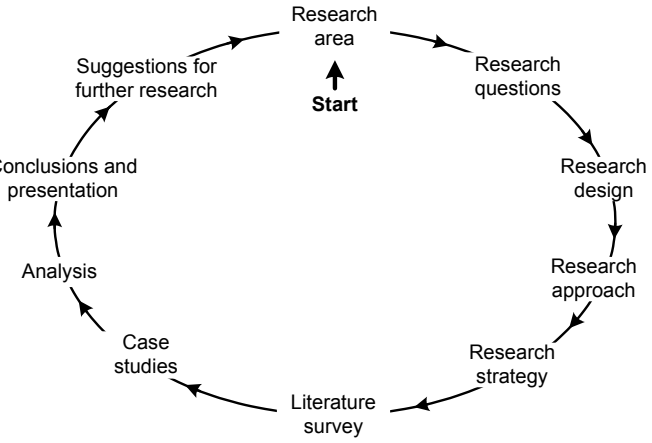

Figure 5 Research process

In this research project, the research area was defined based on needs initiated from industrial organizations. Based on this, the research questions have been formulated and defined. Norman (2003) asserts, "*Research questions define the nature and scope of a research project*". In the next step, the research was designed and conceptualized to enable the research process to move ahead. "*A research design is the blueprint for fulfilling research objectives: answering research questions and/or testing research hypotheses*" (Copper and Schindler, 2003).

In the research study, we attempted to explore the development, delivery and negotiation process of a service strategy, as well as its implementation and execution process and its influencing and performance factors. Our aim has been to increase knowledge in order to understand the "how", "when", "what" and "why" questions that need to be considered when developing and/or implementing and executing a service strategy. A theoretical explanation of the process and its consequences for the work processes was given. Therefore, a *qualitative* method was adopted in this research (see for more discussions Miles and Huberman, 1994; Mason, 1996; Dyllick, 2001).

In the next step, a research strategy was developed to perform the research and fulfill the goal of the research. The developed strategy should be useful and profitable for industry as well as for society. Generally, research can be conducted utilizing methods based on *deduction* or *induction,* or a combination of induction and deduction (*abduction*) (for more details and discussions see Trochim, 2002; Belozerov, 2002; Alvesson and Sköldberg, 1994). At the beginning of the project, a *deductive* research method was used to obtain an overview of the existing knowledge through a preliminary literature survey (*preunderstanding*), which was conducted to identify the needs for performing research and to determine the research questions. When studying and analyzing the empirical information of the case studies, an *inductive* approach was adopted. In the research work, ideas and thoughts were conceptualized from the observation and confirmed using theory, experiences and knowledge from industry by conducting literature surveys and case studies. Thus, the research method used in the Thesis is a combination of the deduction and induction methods (the *abduction method*). Figure 6 illustrates the deduction, induction and abduction research processes.

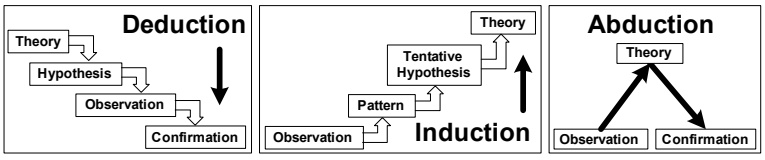

Figure 6 Deduction, induction and abduction process
(The deduction and induction parts have been adopted from Trochim, 2002, and the abduction part from Alvesson and Sköldberg, 1994).

In the next step, we performed case studies. During the research four case studies were performed. Case studies are appropriate to conduct to obtain the real data and information to achieve the objectives and answer the research questions. Yin (1994) asserts, "*A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident*" (also see Yin, 1993). We performed questionnaire-based case studies through e-mail and guided interviews to study existing practices within the service area in industry.

Furthermore, we interviewed industry personnel, participated in an organizational process, and performed *action + research*. *Action research* should be conducted when one wishes to achieve change (the 'action') and understanding (the 'research') simultaneously (Dick, 2002; Dick and Swepson, 1997). "*Action research is known by many other names: participatory research, collaborative inquiry, emancipator research, action learning, and contextual action research*" and action research means "*learning by doing*" (Brien, 1998). During the research work, we conducted participatory action research in which we interacted with industry personnel to become more involved in their process, in order to learn and assist them in solving problems to make the process more effective. Macaulay et al. (1999) highlighted the fact that "*collaboration, education, and actions are the three key elements of participatory research. Such research stresses the relationship between researcher and community, the direct benefit to the community as a potential outcome of the research, and the community's involvement as such as beneficial*".

However, the research methods used in this Thesis can be characterized as interactive research, apart from the methods used in the case studies. Gummesson (2002) stated, "*A package of action and narrative research is interactive research. The element of interactive research represents various interactions, such as between the researcher and the object of study and its actors; between the researcher's consciousness and qualities of his/her inner self; between substantive data and general concepts; between the parts and the whole; between words, numbers non-verbal/body language; and between data collection, analysis, interpretation and conclusions treated as concurrent, non-linear and dynamic elements of scholarly inquiry*".

The next step was to analyze the data and information collected during the case studies. This information was derived from different sources: documents, interviews, direct observations, and participant observations. The information should be relevant and accurate, because it is simply regarded as something that we collected and analyzed to arrive at research conclusions (Norman, 2003).

2.1 Verification and validation of results

Generally, the answers found to the defined research questions should meet the research requirements. The outcome of the research process needs to be verified and validated before it is made available for use and further research (see also Neuman, 2003). During the present study, we collected information from different available resources (e.g. documentation, guided interviews, observations, literature surveys) to ensure the quality and reliability of the information and data (see Copper and Schindler, 2003; Gummesson, 2000; Yin, 1994 for more discussions). Yin (1994) asserts, "*A major strength of case study data collection is the opportunity to use many different sources of evidence. The most important advantage presented by using multiple sources of evidence is the development of converging lines of inquiry, a process of triangulation*[1]". The goal of reliability is to minimize the errors and biases in a study. To verify the results from the case studies further and to guide the research, a reference group was formed with two experienced senior managers and three senior researchers from Norwegian oil and gas industry and academia. The research findings were presented and discussed to assure quality and to verify the results.

In the research study two frameworks were developed based on literature surveys, experience, and observations. The framework was verified and validated through case studies.

The first framework considers the negotiation of service contracts. Some of the results and findings from the case study in question (Case Study II, Appendix 2) are reported in Paper III.

The second framework considers the development, implementation and execution of performance-based industrial service strategies. This framework was verified and validated in three case studies (Case Study I, III and IV, Appendix 1, 3 and 4), which are reported in Paper II, IV, and V. In the first of these three case studies (Case Study I), we mapped the influencing factors as well as verifying and validating the framework on a general basis. In the next two case studies, we further mapped current practices in the O&G industry on the NCS, and validated the influencing factor attributes, as well as mapped performance factors. Case Study III resulted in a modified conceptual framework. Case Study IV concerned the implementation and execution of a developed service strategy. The outcome from the case study supported the conceptual framework and the previous results.

[1] Triangulation: Rationale for using multiple sources of evidence (Yin, 1994).

3 Summary of appended papers

The main objective of Chapter 3 is to summarize the appended papers. Each paper has its individual value and outcomes, but the results reflect and help to fulfill the requirements of the defined research questions. This Thesis includes six journal papers. Some of them are based on a literature surveys and examples from the industry and some are based on a literature surveys and case studies. Three of the six papers have been published, two accepted for publication, and one is being considered under blind peer review in international journals.

3.1 Paper I: Service delivery strategy – trends

This paper reviews recent trends in product support services and service provision processes. The adoption of "solution-selling" and "total care solutions" is becoming common in the market, where service buyers have an option to buy processes or functions instead of physical products. As a result customers can focus on their core business at the same time as the original equipment manufacturer/product owner/service provider can try to maximize the product performance with the least possible operating cost and to achieve their business goals. The involved parties will generate more profit with better performance. Solution selling and total care solutions are regarded as applicable to the mining industry as well as other industries. In this paper, the examples are taken from the mining industry. The product/equipment utilized in this industry is specialized, expensive and used in harsh and demanding environments, as well as in remote areas. Therefore, it fosters to adopt advanced methods of service selling and buying trends to be competitive in the market.

To provide and/or receive any kind of service, one should have a service strategy. The objective of services is to create a win-win situation for all the involved parties. Paper II discusses the service delivery strategy development process and its influencing factors.

3.2 Paper II: Service delivery strategy – a conceptual framework

This paper presents a conceptual framework for the development of a service delivery strategy for industrial systems. When a customer buys a product, he or she expects that the manufacturer or supplier will provide the support and services required to achieve the best possible product performance. The paper focuses on performance enhancement by using improved service delivery strategies and defining critical factors of product support and services with a view to achieving and/or fostering customer satisfaction as well as customer retention. Service and product support can also be a major source of revenue in themselves and can help to increase the success rate of new products.

Various factors need to be considered when developing a service delivery strategy, for example product design characteristics such as reliability, maintainability, the customer's organizational culture and geographical location, operational requirements, etc.

In general, a successful service provider or manufacturer should be anxious to reduce the gap between the required and the delivered services. A modified service gap model is presented which suggests an approach to reducing the gap between the expected and the actually required services. However, in real life it is not always easy to define "what the required services are" since they are often influenced by subjective criteria. Therefore, to succeed, a service provider needs to integrate customer requirements and expectations into service delivery strategies. While providing services, the service performance should be evaluated to make sure that performance data are collected for analysis and feedback to modify the existing service delivery strategy and to minimize the service gap, as well as to prevent such gaps arising in the future.

A service strategy needs to be customized based on customers' needs, wants and preferences. To accomplish that both parties should define which services are needed and when, how, where and why they are needed. If both parties are not agreed, then points of common agreement should be identified and points of disagreement should be segregated. These points need to be analyzed to find the root causes and negotiate to reach one common point of view.

3.3 Paper III: Negotiation of service contracts

Services create additional value for both customers and providers alike. A prudent service provider will adopt those broad strategies that go beyond sales to create incentives that foster customer satisfaction and retention. Success is more likely if the

service provider anticipates and fulfills customer needs, wants and preferences. Therefore, to achieve customer satisfaction and establish a long business relationship, one should negotiate and discuss those services, which need to be delivered. However, it is advisable also to consider services that may be required due to the occurrence of unpredictable failures and unforeseen events.

To achieve the best performance, industrial customers are entering into service contracts with the original equipment manufacturers (OEM) or independent service providers. This, in turn essentially involves service contract negotiation between the OEM/service provider and the client. If such contracts are not negotiated carefully, this may lead to conflict and poor system performance. Thus, a negotiation process plays a vital role in developing effective, efficient and competitive service delivery strategies that ensure customer satisfaction and customer retention. Aspects such as what services to deliver, who is to deliver them, how they are to be delivered and received, and at which performance level need to be considered in the negotiation process and agreed upon by both the provider and the client.

The paper presents a framework that illustrates which factors need to be considered when negotiating a service contract (i.e. the key contents of the negotiation process). The paper discusses why these factors are important and what the consequences are if these factors are not considered in the negotiation process. Furthermore, the possible service delivery interfaces between the different service provider(s) and the service receiver are discussed. The negotiated agreement should describe the key content and scope of the service agreement, responsibilities, and expected performance levels.

In the service agreement, there should be a clause for renegotiation of the service contents and delivery process, since requirements and levels of services vary based on the performance of the existing services strategy. Moreover, the service strategy should be modified and updated in accordance with changes in customers' needs, wants and preferences and with changes in the service strategy's influencing and performance factors. Thus, the service strategy development process is an evolving process.

3.4 Paper IV: Framework for performance-based service strategies

The paper demonstrates the importance level of influencing factors, their attributes and performance factors for the service strategy. The criticality and importance of the factors vary and need to be customized based on the requirements of the project and the customer. This is due to increasing demands for a higher profit margin, reduction in operational expenses and the involvement of the organization in the work processes

based on their core business goals. Furthermore, the paper suggests which factors and attributes that need to be considered when developing a service strategy.

The paper presents a framework for performance-based service strategy. The framework has been developed based on a literature survey and an analysis of the empirical data collected in a case study from the Norwegian O&G industry. In the paper, influencing factor attributes are listed according to their degree of influence on a service strategy. Furthermore, the framework demonstrates that performance feedback from the process is an evolving process.

3.5 Paper V: Service strategy implementation and execution

In this paper the implementation and execution process of a performance-based service strategy is discussed. The discussion is based on a literature survey and a case study. The paper presents the importance of having a good implementation and execution plan and the performance factors for different types of contracts. These factors need to be considered when developing a service strategy. However, in real life it is often not possible to define and predict all the major factors that need to be considered. Some of the factors come into the picture during the implementation and execution process. Therefore, one should prepare to deal with and adapt to them, and be flexible enough to modify and upgrade the existing project execution model. Each factor has its own importance, value and influence on the work processes. For instance, good communication and trust, a good relationship, a clear goal and scope, and clear objectives play vital roles in reducing uncertainty, speculation and unfounded fears during the implementation and execution phase. One should establish good communication throughout the implementation and execution process to monitor what is actually happening, to analyze how to deal with emerging problems, and to decide what modifications might be needed in the program to make it work or seek solutions to problems.

3.6 Paper VI: Support services –performance enhancements

This is an explanatory paper where we mapped and discussed the current practices and future trends in the industrial service area. The paper presents how companies use technologies to improve work processes, at the same time as they reduce the operational expenses. Advancements in ICT have made it possible to inspect, supervise, and control processes 24-7 remotely and away from the production or operation site. ICT also enables access to experts located in different parts of the

world. Companies and organizations can use emerging technology to improve performance and develop smart operations, maintenance, and support (OMS) processes, to become more competitive on a global scale, and to increase profits. The Smart OMS concept enables the operators to make critical decisions in critical situations at a critical time based on critical information and critical communication. Operation and maintenance experts can make better decisions based on improved communication, information, and documentation with the help of technology advancements and preciseness in data transfer.

The smart OMS concept is demonstrated through examples from the oil and gas industry showing the saving potential and performance improvements. The examples show that ICT plays an important role for reservoirs in the tail end production phase where potential profits are highly dependent on the ability to reduce operational expenses (OPEX) and/or to increase recovery.

4 Discussion and conclusions

The main objective of Chapter 4 is to present an overall view of the research study, and to present and to discuss some of the main findings. We discuss factors and attributes, which influence service strategies, their development and delivery processes of service strategies, and performance measurements. In the previous sections, it was noted that to achieve customer satisfaction, it is necessary to support a product and provide support for the customer using the product. To provide support, one should develop service strategies considering major influencing factors and performance factors.

In the present research study, two conceptual frameworks were developed as well as being verified and validated through a series of case studies. A conceptual framework was developed for service delivery strategy based on literature surveys, field experience, and a case study (Case study one, Appendix 1). Similarly, a conceptual framework was developed for the negotiation of service contracts (Case study two, Appendix 2). To develop the conceptual framework of the service delivery strategy further, two more case studies (Case studies three and four, Appendix 3 and 4) were performed – both in the O&G industry. Case study three focused on the service strategy development process. Case study four focused on the service strategy implementation and execution process.

4.1 Case study I: Service delivery strategy

A questionnaire was developed and presented to companies from Sweden and Norway involved in manufacturing, maintenance, etc. The case study showed that a service provider needs to consider major influencing factors, as shown in Figure 7, to develop an effective service delivery strategy and minimize the gap between the delivered services and the required services (for more details see Paper II). Some of the results are discussed below.

The analysis of the results from the surveys shows that most of the companies are focused on the reliability of the product and pay scant attention to the maintainability characteristics of the product. However, both are important, since reliability defines product tolerances and failure frequency, whereas maintainability defines the level and type of resources that are needed for performing planned and unplanned maintenance (Paper II, see also Dummer and Winton, 1990).

The case study also shows that companies develop their service delivery strategy based on the product's functional requirements, whilst requirements related to customers' needs with respect to using the products come second. However, based on the study we found that a focus on support to the customer is equally important for achieving the objectives of a service delivery strategy (for further discussion see Paper II, see also Markeset, 2003; Mathieu, 2001a and 2001b).

Excellent and appropriate service quality is what satisfies both customers and suppliers/manufacturers. When properly executed, service provision meets or exceeds customers' expectations. Zeithaml et al. (1990) assert that a customer would consider performance as excellent if a repairman not only fixed a broken system, but also explained what went wrong and how to prevent/manage similar problems in the future. In this situation the customer would be satisfied and the service would exceed their expectations. In real life it is not always easy to define what "required services" are, as they are often influenced by subjective criteria. Customers may have different expectations regarding services from what is defined by a manufacturer/supplier. To be successful, a framework is needed in which customer requirements and expectations are integrated in service delivery strategies.

The case study indicated that a performance evaluation is needed to assess the degree to which a goal or objective has been achieved. Performance measurements depend on data/information and clear objectives for performance. For more details on performance measurement systems for the O&G industry (see Kumar and Ellingsen, 2000; Liyanage, 2003; see also Åhrén, 2005; Parida et al., 2005; Ellis and Curtis, 1995).

4.2 Case study II: Negotiation of service contracts

The main purpose of this case study was to assess the content and the influencing factors needed for negotiating a successful service agreement. The target group for this survey was senior managers involved in product support and service delivery contract negotiations. An effort was also made to contact managers by telephone for discussions and to obtain a deeper insight into the negotiation process.

The case study questionnaire was divided into two parts. The first part contained an open-ended type of questions and the second part contained multiple-choice questions. The questionnaire dealt with the following areas: the key content of a service delivery negotiation process, the factors influencing the negotiation process, the timing of the negotiation process, the duration of the service delivery contract, and the service agreement follow-up. The questionnaire was sent out to Norwegian companies involved in the manufacturing of and provision of services for industrial products, and the buyers of such products. The results are presented in Paper II. Some of the results are discussed below.

The case study indicated that there are several key elements in any service delivery contract negotiation. The manufacturers keep the main focus on the service goals and the scope of the work, the payment terms, maintenance goals, and organizational goals. On the other hand, the customer focuses on the price and the delivery time of the service, spare parts, etc. Some companies considered product reliability as a key part in the service delivery negotiation. The key elements of a service negotiation process identified in the case study are listed below:

- Goals and scope of work
- Payment terms
- Product reliability
- Price
- Training and documentation
- Overhaul and maintenance mission
- Spare parts management
- Operational requirements

The survey shows that most of the companies share the same key elements. A notable exception was the aviation industry, where the main focus was on safety. Most of the companies recognized that it was also necessary to consider not only the product reliability, but also the product maintainability. This was because they tended to believe that reliability defines product tolerances, and maintainability defines the resources and the time required for service delivery (*as noticed during the first case study as well*). However, most of the OEMs (original equipment manufacturers) indicated an awareness of the influence of the RAMS (reliability, availability, maintainability, supportability) characteristics on the dimensioning of product support.

Furthermore, this case study indicates that, when negotiating a service contract, the participating manufacturing companies/service providers focused on the geographical location, the operational requirements, the availability of competitors, the customer's own capabilities, etc. On the other hand, the customer focused on the history of the product performance, the reputation of the service provider, etc. Moreover, factors that emerged as important to consider during the negotiation

process were: the customer's organizational culture and the competence level of the service personnel, the OEM's/service provider's own capabilities, government rules/regulations, and the customer's corporate strategy regarding the purchasing of services. The case study shows that, if these factors are not considered in the negotiation process, there is a possibility of conflict between the involved parties.

Furthermore, the survey shows that most of the companies negotiated the product support and service delivery before buying the product/system. However, they focused less on the service strategy development, implementation and execution. Support/services and their delivery process need to be defined after the installation and during the operation phase. The customer should negotiate the supporting services at the time of purchase as well as during the system's operational phase.

Based on the responses of the survey, we concluded that the service delivery negotiation process should be carried out before selling a system and conceptualizing the service contents and the delivery process. If the services are not defined during the buying/selling process, misunderstandings are more likely to occur and lead to undesirable problems and/or loss of business. However, in the negotiated agreement there should be a possibility of renegotiating the services if needed.

- All the participants of the survey indicated that they assessed the performance at the end of the contract follow-up to check the success of negotiated agreements. Service delivery companies said that they carried out a performance measurement process by seeking feedback from customers, by measuring product downtime, by assessment of expressed customer satisfaction and by soliciting feedback through meetings with customers and through interviews. Some of the performance measurement instruments used by the participants are:
- Feedback from customers (complaints/praise)
- Performance parameters established jointly by the manufacturer, the suppliers/providers and the customer as per the governing general terms of the agreement
- Regular meetings
- System/product/equipment downtime measurements

The results indicate that performance measurement of the actual service delivery is essential. It helps to measure the customer satisfaction level and to improve the performance of the existing services. The goal should be to make the delivery of the services problem-free and reduce the gap between the required services and the delivered service (see Paper II and III).

Figure 7 illustrates the conceptual framework for development of a service delivery strategy. In the framework, we have considered major influencing factors.

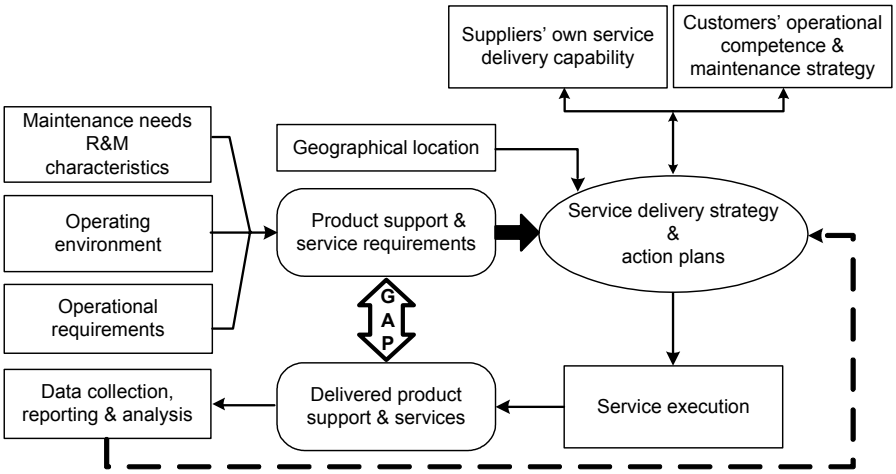

Figure 7 A conceptual framework for development of a service delivery strategy (Paper II)

Furthermore, in the second phase of the research work, two more case studies were conducted to validate the conceptual framework (Figure 7) and to study in depth and define the influencing and performance factors. The conceptual framework and literature surveys were used as a foundation for formulating Case Studies III and IV. The case studies were performed in the oil and gas (O&G) industry operating on the Norwegian Continental Shelf (NCS) and the United Kingdom Continental Shelf (UKCS). However, the main focus was NCS.

Players involved in the O&G production facility want the best possible performance (e.g. concerning profit, costs, HSE, availability, deliverability, etc.) out of the production process at the lowest possible cost, as shown in Figure 8. To achieve this, all the parties who are involved in and/or influence the operational performance of the production facility need to deliver the best possible integrated performance according to the defined needs, wants, and preferences of the production process. The owners and the operators need to decide the performance goals, resource use, and support service requirements. On the other hand, the service providers need to decide on how they can help their customers to achieve their performance goals, and find ways to deliver the services in the most efficient way to reach the performance goals of the involved parties (Anderson and Narus, 1995; for more discussion see Paper IV and VI).

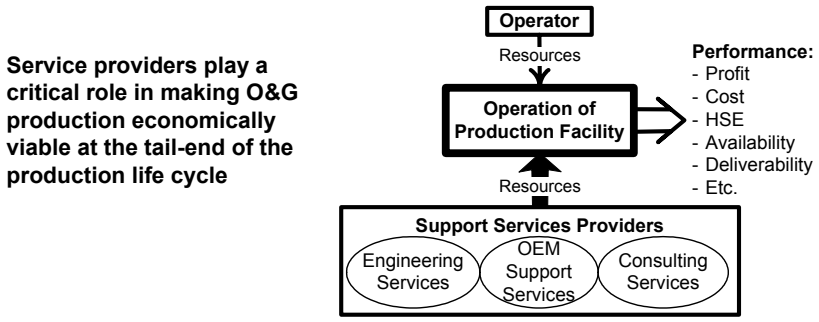

Figure 8 Service provider's role in enhancing the operational performance of an O&G production facility (Paper IV)

4.3 Case study III: Performance-based service strategy

This survey focused especially on the external and internal services needed to support (or perform) O&G operations and maintenance activities. The main purpose was to map the existing service strategies and collect data and information to develop a performance-based service strategy for the O&G industry. Moreover, we intended to validate the influencing factor attributes and to map service strategy performance factors (i.e. cost drivers, performance killers, critical success factors).

The case study was divided into three sections, with the first section focusing on mapping the existing practices. The second section focused on validating the service strategy's influencing factor attributes. The third section focused on mapping the performance measurement methods, which the companies use and perceived to be important in the development of a service strategy. Performance factors such as critical success factors, performance killers, and cost drivers were also mapped (see Paper IV for more discussions, methodologies, processes, etc.).

Figure 9 illustrates the framework for the development of performance-based service strategy drawn up on the basis of the case study. The framework links a service provider's service delivery strategy (SDS) with a service customer's service reception strategy (SRS). The SDS and the SRS need to be aligned to avoid gaps and conflicts. The goal of the framework is to develop an effective and efficient service strategy and create a problem-free implementation and execution process. This should help to create a win-win situation for the involved parties.

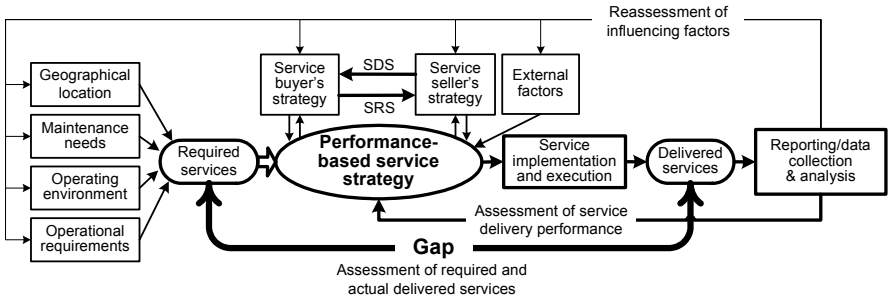

Figure 9 A framework for the development of a performance-based service strategy (SDS: service delivery strategy, SRS: service reception strategy) (Paper IV, V)

The survey confirms that there is a need for developing a performance-based service strategy that considers and takes into account influencing and performance factors. Many performance factors were found. It was observed that most of the influencing factors are considered to be important for a service strategy. However, each individual influencing factor attribute must be considered individually based on the circumstances, as well as the needs, wants and preferences of the participants in the service strategy development process (for more details see Paper IV).

4.4 Case study IV: Service strategy implementation and execution

The main purpose of this case study was to map the existing service implementation and execution process and to find performance factors. We have mapped the contents of two ongoing contracts, namely a maintenance and modification (M&M) contract on the Norwegian Continental Shelf (NCS) and a performance-based operational (PBO) contract on the United Kingdom Continental Shelf (UKCS). Furthermore, we gathered data and information by interviewing personnel from top management, middle management and the operative level.

Based on the responses of the survey, we found that the service implementation and execution process is the checking ground of a developed service strategy. The service strategy needs to be modified according to the requirements of the project and customer. The implementer and executer of the M&M contract stated that they developed a project execution model (PEM) at the beginning of the project and carried out a follow-up during the project life cycle. However, they were flexible enough to modify the PEM if there was a gap between the required services and the delivered services. The implementer of the PBO contract stated that their PEM has

been changed since they started. However, their PEM was not as detailed as the M&M contract's PEM. In the PBO contract they kept modifying and upgrading continuously according to the needs of the project and customer.

Furthermore, responses from the participants show that they use various methods to assess contract performance and collect data and information from their customers, suppliers and own employees. Some of the methods used include: regular meetings to discuss the progress and obstacles of the implementation and execution process, assessment in relation to the budget and KPIs, quarterly performance reports, and expenditure assessments. Some of the participants expressed that they used systematic and well-defined performance measurement systems, for example First Point Assessment Limited (FPAL) to compare the sub-supplier's price and performance level and European Federation of Quality Management (EFQM).

This case study shows that a number of key performance indicators (KPI) are used to evaluate and judge the performance of the service strategy. These KPIs are related to different areas and types of specialization (e.g. HSEQ, production and production support, OPEX, financial operational performance, progress, time/quality, competence, innovation, actual work versus planned work, customer satisfaction index, etc.). One company expressed that on the corporate level, 167 different types of KPIs were registered, although not all had similar intentions and purposes. Moreover, the KPIs reflect different areas of the execution process and evaluate the performance of the service delivery as a whole (for further discussions see Paper V).

The participants of case study III and IV stated that a decline in O&G production could affect the service needs and requirements of a production facility. However, rapid changes in technology will not affect the content of the services.

In short, this research study is focused on service strategy development, negotiation, implementation and execution. Trends show that industrial services are becoming increasingly important and that improvements are needed in industrial strategy development, negotiation, implementation, and execution processes. The potential of strategic assets like product support, supporting services and their implementation and execution process, can be better exploited to enhance an organization's competitiveness and profitability. Companies increasingly are using different kinds of service offerings, ranging from conventional service contracts to total care solutions where the service provider delivers services based on performance. This Thesis suggests two frameworks for improving service strategies. The first framework considers the development of negotiation of service contracts and suggests key factors that need to be considered to develop a healthy relationship and to avoid conflicts. The second framework was first developed as a conceptual framework based on literature review, experience and observations. This framework is further developed for the O&G industry in the North Sea based in extensive case

studies. The framework considers factors and attributes that can influence a service strategy development, implementation and execution. Furthermore, based on the case study, performance factors are suggested as well as a strategy for assessment for a potential gap between required and actual delivered services, assessment of the service delivery process. Moreover, the research suggests that it is necessary to reassess the service strategy, influencing factors, their attributes and performance factors at regular interval to realign the strategy to fit the changing business needs of service provider and customer.

5 Research contributions

This research work focuses on the development, implementation and execution process of industrial service strategies. We found that little research has been performed considering influencing factors, their attributes and performance assessment and that there is a need for suitable industrial service strategy frameworks. Based on the case studies, literature surveys and field experience, we propose two conceptual frameworks that provide a foundation for the development, negotiation, customization, delivery, implementation and execution of industrial service strategies.

The first framework provides a foundation for improved negotiation of service contracts and highlights the importance of describing key content, scope of service agreement, responsibilities, and performance levels. Negotiation also plays an important role for win-win outcomes. A good and effective negotiation process can improve the quality of services by addressing relevant details in advance (e.g. the content of the service, the delivery process, obstacles of the process, etc.).

In the second framework, the development, implementation and execution of performance-based service strategies, we integrate the influencing factors and their attributes, as well as performance assessment considering gaps between the required and the delivered services. To develop competitive and effective service strategies, it is necessary to consider major influencing factors, their attributes, and the performance factors of the strategy development, implementation and execution.

Furthermore, the Thesis emphasizes that service delivery strategy and service reception strategy need to be aligned to achieve better service delivery performance, as such an alignment will lead to customer satisfaction, as well as secure customer retention. Basic reasons for the failure of service delivery strategies, reasons for service gaps, reasons for conflicts, influencing factors and performance factors have been assessed, and issues and challenges with respect to service strategy have been discussed.

5.1 Suggestions for further research

Many manufacturing companies have the potential for improving their competitiveness through providing industrial services that can help the customers in achieving better performance of their products. However, some companies lack the capability to recognize their potentials and markets in this respect. Therefore, research is needed to help such companies to innovate new services with respect to the service content and service delivery process.

Since service strategy performance is based on communication and relationship building, studies need to be performed on how communication within management and operative personnel as well as with the involved parties can be improved to enable faster and better decision-making processes based on accurate, timely, and concrete data and information.

Furthermore, more research needs to be performed on industrial services to enhance the product performance and improve the technical integrity of advanced, complex and integrated production facilities. Integrated services need to be developed based on condition monitoring, diagnostics and prognostics techniques.

More detailed research is needed on total care solutions and the delivery of functional products where the customer only buys the product function and not the physical product. Such studies should include research on how to integrate further customer needs and requirements with respect to services to support products as well as services to support the customers.

Various sourcing strategies are being used in industry at an increasing rate. Studies need to be performed to identify the various types of contract, and the terms and conditions of contracts with respect to services. Moreover, improved contracts have to be developed which take into account performance criteria and new forms of international collaboration. In addition, knowledge needs to be generated on how various kinds of collaboration strategies based on out/in/co-sourcing, partnering, joint ventures, etc. can be further developed to create win-win relationships for the involved parties.

Performance measurement systems need to be developed systematically which include and take into account key indicators such as cost drivers, performance killers and critical success factors related to technological, organizational, and human issues.

New and emerging technology, such as information and communication systems (Internet, cellular phones, broadband, etc.), can be used to enable new, faster and improved services. However, research and development need to be carried out on how to integrate these technologies into industrial service processes and products.

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Part II – Papers

Paper I

Kumar, R. and Kumar, U. (2004), "Service delivery strategy: trends in mining industries"

International Journal of Surface Mining, Reclamation and Environment, Vol. 18 No. 4, pp. 299-307.

Service delivery strategy: trends in mining industries

Rajesh Kumar and Uday Kumar
Luleå University of Technology, 971 87 – SE, Luleå, Sweden
Telephone No. +46 920 49 1826
Fax. No. +46 920 49 1935

Abstract

Mine operators are increasingly outsourcing non-core business processes. Often, the maintenance issue is treated as a non-core business by the mining industry. In today's business environment, many industrial operators/users are interested in buying performance rather than physical products. It is a common practice for an original equipment manufacturer (OEM)/supplier of a product to own, operate, maintain, and support his product. Product performance in general is defined in a negotiated agreement. Even in a conventional product scenario a user/mine operator often prefers to outsource maintenance to OEMs or contractors in order to focus on core business goals. This paper reviews the recent trends in delivery of product support within segments of the mining industry. In this paper, we advocate the adoption of 'solution-selling' and 'total care solutions' into the mining industry. There appears to be a strong likelihood that these concepts can benefit the mining industry. Solution selling and total care solutions are seen as applicable to the mining industry because the product/equipment utilised in this industry are specialised and often expensive. The strategies addressed in this paper support a mine operator's option to buy processes instead of physical products, and the increasing demand for a total solution.

Keywords: Conventional products, functional products, full service, outsourcing, total care solution, mine operation.

1 Introduction and background

State of the art mining systems are large, complex, automated, and integrated. During the last two decades, a dramatic increase in mining equipment size and technological complexity has resulted in higher equipment maintenance and service costs and created a strong demand for highly skilled maintenance personnel. Such systems are often used in harsh and demanding environment that are characterized by heavy loads, shock loads, heat, cold, and humidity. Personnel with varying degrees of training, skills, and experience carry out operations. In addition, equipment needs to be operated for long hours with few failures. This places a high demand on machine and equipment uptime performance. An effective maintenance organisation is essential for equipment to function at the level desired. For many companies with a high degree of mechanization, maintenance spending accounts for a significant part of their operating budgets but "service and maintenance areas" are still considered a minor element in strategic operations planning. There is a perception prevalent within the mining industry that high maintenance and service costs are an inherent part of the operations. To minimize what are perceived as complex problems associated with maintenance management, mine-operators prefer to outsource maintenance or purchase only the required "functions" of a machine along with availability guarantees. Mine operators typically view this strategy as a way to transfer ownership risk from the operation to the OEM (Original Equipment Manufacturer) or distributor. With advent of this trend, focus has shifted to the design of functional products. The definition of a functional product is that a user is not buying a machine/system but the function that it delivers (for details, see [1]). However, to truly maximize profitability, mine operators and OEMs need to develop relationships that allow both parties to share the risks and benefits of maintenance and service optimization [2]. "Total solution selling," offers this possibility in functional products. In this approach, an OEM/supplier solves direct as well as indirect problems related to a product. This trend is just coming into use in the mining industry from the other industries (e.g. the airline industry).

When delivering services and maintenance an OEM/supplier develops a service/maintenance delivery strategy that considers product support requirements and customer requirements. The introduction of innovative technologies has transformed existing products and brought new ones into the marketplace. Greater complexity and knowledge unknown a decade ago have placed greater demands upon both manufacturers and product users. These stringent knowledge requirements have changed product support requirements. The product support department of an original equipment supplier (OEM) develops service delivery strategies based on experience and empirical practices.

Generally, an OEM designs and manufactures a product (mining equipment). OEM activities are shown in Figure 1. Service and maintenance may be provided by the technical support division of an OEM or by an independent support service

provider. Prudent OEMs collect data during system/equipment operation for use in next generation design, development, manufacturing, installation and commissioning.

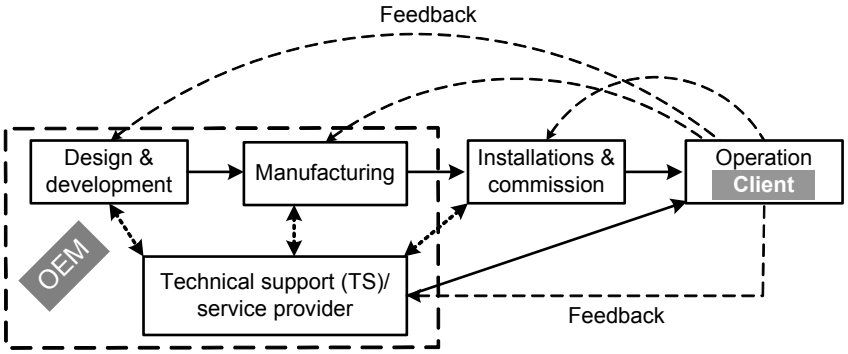

Figure 1 Overview of Service Delivery Strategy

In this paper we will discuss different type of products on the basis of product services offered by an OEM/supplier that considering user/mine operator operational requirements of the user/mine operator. We will focus on functional products where a user/mine operator buys only performance or total solution of a product.

This approach to service delivery strategy is greatly influenced by product types and customer needs. The product types can often be broadly divided into two categories based on ownership of a system/machine/product as illustrated in Figure 2.

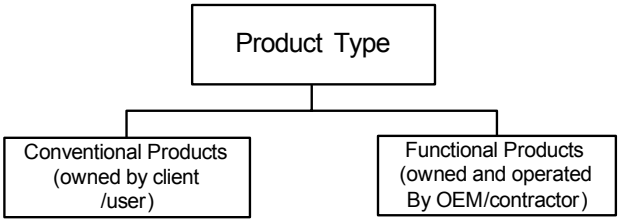

Figure 2 Product types based on ownership

2 Conventional products: types of offering/ services

In conventional product scenarios, the user owns the product/system (e.g. a mine-operator). Service and maintenance is needed to compensate for system weaknesses and this is provided through support to product and support to customer strategies. The purpose of customer support is to assist a customer in maximizing all processes

(including operations and maintenance), actions, and strategies related to a product. The ultimate need being to optimize a product's profit making potential. With conventional system selling, an OEM can sell a system directly to a mine operator or through its regional network. Exactly which strategy is used is based on customer needs and preferences. Some of these alternatives are discussed in the following sections.

2.1 Type I - Physical product selling offering

This is the oldest and most traditional approach where a user/mine operator normally buys a system, performs the operations, and maintains the system. Expert assistance as well as original spare/ warranty parts may be required from an OEM and/or third party. Advanced training may be needed to ensure effective and efficient operation and maintenance. Over operating life, systems may benefit from modification and upgrading. An OEM/supplier interacts with a customer's maintenance function to supply what in the literature is commonly described as "after-sales service". A user/mine operator must budget for system purchase, any unavoidable services that compensate for system weaknesses, and possible supplementary services that help to optimise system exploitation. For example, an OEM sells a drilling machine to a mine operator. The mine operator operates and does all necessary maintenance keep the machine in its proper operating state. The OEM provides support to the mine operator and drill machine by making available original parts, unique tools, training, etc. With this approach, an operator performs all maintenance work related to a machine.

2.2 Type II - Product + service/maintenance selling

In this approach, an OEM sells a system with an accompanying attractive bundle of service and maintenance provisions. Maintenance work is partially outsourced to the OEM or a service supplier. While the mine operator outsources some or all maintenance work, they still own the product and their employees operate it. Often a mine operator prefers to have an in-house maintenance organisation for better control of assets and availability. Mine operators typically prefer to outsource maintenance tasks that require specialized knowledge or facilities. This approach is known as partial outsourcing. For example, in the case of a drill machine, a mine-operator can choose to outsource for maintaining hydraulics and IT related services to the OEM or to some independent service provider.

Alternatively, a mine operator/user may choose to outsource all maintenance work to an OEM or supplier. Due to the probability of fast technological developments a management may prefer to focus attention and resources upon core business activities. Less and less, do companies seem to want to buy a system, use it and maintain it; the preference is to outsource maintenance/services so as to share business responsibilities with an OEM/supplier. Outsourcing is viewed as a means to

ensure far greater cost discipline while at the same time improving quality of service and product delivery capability. For instance, returning to the drill machine, a mine operator outsources all maintenance related work (not only the maintenance of hydraulics or a particular drilling machine part). Mine operators/companies use outsourcing as a means to focus on core business and thereby minimize business risk plus to increase competitiveness. Outsourcing has changed not just the face of the workplace but also societal attitudes towards work and employment. It creates for companies and entrepreneurs' new avenues and opportunities for growth. The ability to secure a system and services at lowest cost with higher quality is viewed as a prudent business strategy. Different companies may outsource different services. For example, maintenance, training, recruitment, benefits administration, facilities maintenance, materials handling, logistics, stores, purchasing, and complete HR activities are all elements of a business that are considered non-core and open for outsourcing [3]. When a mine-operator outsources maintenance for a drilling machine, the operator may furnish equipment and spare parts while the OEM/supplier provides people, management, and technology.

The decision to outsource is usually based on the premise that an OEM/supplier has some inherent advantage over the host company varying forms of shared supervision. This can cause conflict between an OEM/supplier/contractor's worker and a host company. Since officially the worker is under the administrative control of contractor while in reality the host company controls them. Therefore, terms and conditions related to the role and responsibilities of all actors should be clearly defined in the contract (negotiated agreement) to avoid loss of control, reduced competence, and decreased operational flexibility. Recently conducted surveys report high levels of dissatisfaction with outsourcing [4]. On the other hand, outsourcing, when carefully managed, offers excellent potential in sharing of business risk and enhancement of business performance between partners. Outsourcing is often a matter of trust and cooperation between the parties involved. The main driver of outsourcing is to achieve cost benefits. The available literature [5,6] all offers details on management of different elements in outsourcing.

2.3 Type III - System + services + support + knowledge (Full service)

With this newest type of strategy a customer/mine operator owns a system but all required support to mining equipment and support to equipment operators related services are provided by the OEM or equipment supplier at agreed prices or as part of the original selling price. This combination of system, services, support and knowledge from an OEM to a mine operator means that full service is provided. Full service in the mining industry usually means that the OEM/service provider executes all corrective, preventive and predictive maintenance activities as well as support to equipment operator/customer (for detail, see [7]). Such support ranges from training to machine maintenance. A critical element is that support is given to a mine operator

for using the drill machine effectively and efficiently. In this form of full outsourcing an OEM/service provider is responsible for providing an agreed level of availability and reliability. Knowledge provided includes what, when, why, and how a drill machine is used to achieve maximum profit. This is more or less an individualized problem solving service sold to a mine operator/customer as part of a package [8].

Service selling

An OEM offers services-only as an independent product and can even provide services for competitors' machines under agreements with end users. Competing with OEMs in the market are independent service or maintenance organizations. They generally provide only after sale service to a system and do not sell new systems. Often they are known as a service specialist company. In the instance of a drilling machine service provider company, maintenance or services that keep the machine in its operating state are offered to mine operators. A service company may be a part of an OEM functioning as a semi-independent technical support division or it can be an independent service provider that may or may not have some form of a business relationship with one or more OEMs.

3 Functional product: types of offering/service

In the functional product scenario, an OEM/supplier focuses on optimizing the same processes that a customer is interested in optimizing. With functional product selling, an Original Equipment Manufacturer (OEM)/supplier can sell performance of the system not the system/equipment itself. The manufacturer is responsible for negotiated costs and agreed performance. Some alternatives are discussed in the following sections:

3.1 Type IV - Sale of process/function (Solution selling)

Selling of the function/performance of the product by the OEM/supplier is an advanced form of Type III's outsourcing and full service. Here, an OEM is responsible for operating, maintaining, and supporting a product in addition to its design and manufacture. This trend is becoming popular as purchasing only the required functions/performance of the mining equipment means being able to focus on more central activities within the overall mining operation. An OEM/supplier is responsible for the delivery of performance as per negotiated/agreed terms and conditions. Thus, services to support the product or to support the customer have to be an integral part of the function to be delivered. In this scenario, the manufacturer has potential profit from more than just after sales support services. At the same time, product support can, if improperly managed, become a cost and liability for the manufacturer. Still, the possibilities for profit maximization are good as an OEM typically has knowledge and resources that allow it to identify and realize savings that would be invisible to the operator. For the mine operator, the cost of purchasing

process/function can in many cases be less than costs associated the strategies described in Types I-III; the potential for profit is greater. Importantly, this arrangement can create a long-term relationship and business opportunity between customer and OEM/supplier. [1, 9] describe some of the possibilities identified in other industries; the applicability to mining becomes evident during reading. In previous sections, we discussed scenarios where a customer/mine operator purchases (owns) a product/system and operates it. Since the customer is primarily interested in obtaining benefits of function, [10] (i.e. a customer is interested in the hole drilled and not the drilling machine) a scenario can be constructed where a customer/mine operator chooses to procure through outsourcing only the function/performance of a system/product.

As noted above, there are negative points too associated with solution selling. For example, solution selling is very complex as a takeover of all maintenance/service activities for a system by an OEM/supplier leads to increased risk for the OEM/supplier while removing control from the hands of mine operators. Operators may feel uncomfortable because they have less control over processes. This feeling of loss of control and comfort is a major roadblock in implementing the concept of purchase of process or function. The inherent risks cause them to be reluctant to accept the functional product concept. Poor planning, communication and management of the functional product concept can be a reason for conflicts among companies and threats of contract loss, as well as customer and business loss [9]. In the most extreme instance, the provider miscalculates costs so greatly that they fail; the operator has paid in advance and/or planned for services that will not be forthcoming meaning that they will fail also.

3.2 Type V - Total care solution

In total care solution approach, an OEM/supplier not only sells performance and/or function but also helps a user to realize his visions/goals. The assistance may be directly or indirectly related to a product and it may even provide solutions that have no visible link to the OEM's/supplier's own product or function. Such services are gradually gaining popularity in many industries and mining is no exception. This is an advance form of the functional product described in Type IV. With a functional product, an OEM/supplier sells system performance whereas with a "total care solution" an OEM/supplier sells system performance along with types of services that support achievement of success with core processes. Total care solution concept is frequently called "total solution selling". In total solution selling an OEM/supplier indicates that their system or service can address a vision of a solution in which the OEM/supplier and customer/mine operator both will participate. When properly executed, total solution selling allows a customer to use the market to identify which OEM/supplier is particularly best at doing what within necessary timeframes via a unique system or set of services (for more detail see [9] for further discussion about

total solution selling). Total care solution selling is more than selling of a product and included support. Included are all customer/mine operator activities that are directly or indirectly related problems of core processes. Comparable is the petroleum drilling industry where purchase of services from major service companies is dictated by conditions or needs at a particular site/region.

If we use the example of the drilling machine, an OEM/supplier sells only the hole the machine drills to a mine-operator. Rather than the mine operator, an OEM/supplier determines how to handle strata being drilled through, which type of explosive to use, required hole depth, and so on. A mine operator has told an OEM the job's ultimate goal and the OEM/supplier develops a plan to fulfil the mine operator's goal. The "Total Care Solution" aims at delivering performance and services that fully support customer activity.

In a sense, product support philosophy has been undergoing a development process. Each of the five types described can be likened to a stage in the process as shown in Figure 3.

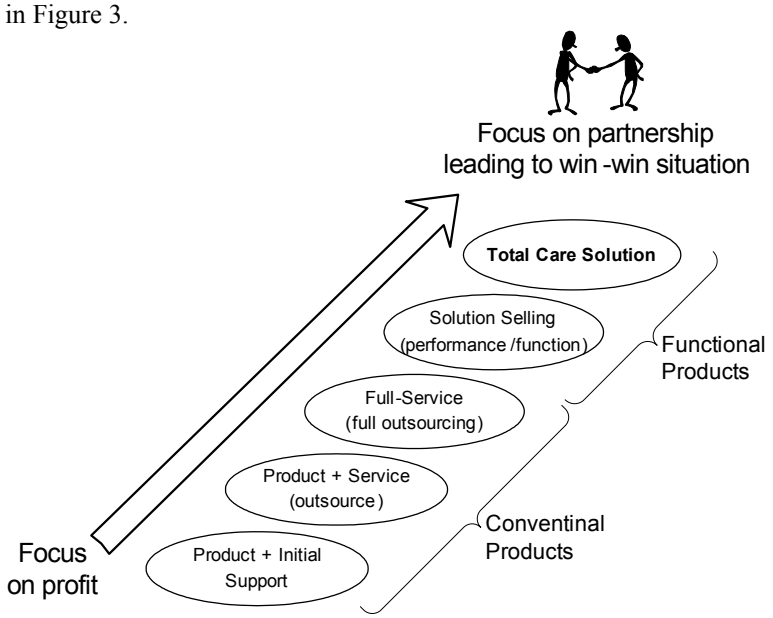

Figure 3 Paradigm shift in delivery of product support

4 Concluding remarks

Mine-operators are interested in products that will produce quality output at minimum cost and at a market-driven rate/time generating maximum profit. In a

conventional product sales scenario an OEM/supplier potentially can profit from selling a product, from selling services to support a product, as well as selling services to support a customer. A mine operator is then responsible for optimization of an operation's performance maintenance processes. The mine operator must also reduce costs related to external services, which is a traditional profit area for an OEM.

When a supplier/manufacturer offers functional products to several customers conflicts may arise where priority of resources (expertise, spare parts, etc.) is critical. One challenge will be to meet multiple needs of several customers and to make best necessary trade-offs that simultaneously satisfy all user/mine operator customers. When a mine owner purchases functional products from several manufacturers problems may arise with respect to coordination and cooperation as well as effectiveness and efficiency. The mine owner must assess the ability of manufacturers to deliver the performance or service with negotiated agreements, make potential problems readily manageable.

The concept of functional product place maintenance and support in a new perspective where design for high performance at lowest cost becomes the goal. Finally, the advance form of functional service sales is the "total care solution" where an OEM/supplier provides to a user/mine operator performance of a product as well as services that solve indirect problems, which may occur during or after buying of performance.

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Paper II

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A conceptual framework for the development of a service delivery strategy for industrial systems and products

Rajesh Kumar and Uday Kumar
Division of Operation and Maintenance Engineering
Luleå University of Technology, SE-97187 Luleå, Sweden

Abstract

Service and product support have become increasingly critical elements in the achievement of customer satisfaction and for winning new markets. When customers buy products they expect manufacturers/suppliers to provide product support and services that make it possible for them to achieve best possible performance (world-class performance). The success of a product support strategy depends on how effectively these services are delivered. The focus of the paper is on performance enhancement through the use of service delivery strategies; critical factors in the marketing of product support and service related contracts that, in turn, foster customer satisfaction.

This paper presents a conceptual framework for development of service delivery strategies for industrial systems in a multinational environment. Considered in the framework are product design characteristics such as reliability, maintainability, customer's organizational culture and geographical location. This conceptual framework considers strategic elements for functional as well as conventional products. The paper advocates an increased focus on support to customer within the framework, introduces a modified service gap model and suggests an approach that reduces any gap between expected and required services. An evaluation of service delivery performance is emphasized.

Keywords: Industrial systems, product support, reliability & maintainability, service delivery strategy, multinational environment, customer needs and wants, service gap model

Introduction and background

A long-established practice of firms engaged in the manufacture of goods/products is to provide customers with some degree of product support and service. Customers, in turn, expect that the manufacturer/supplier will offer product support. The manufacturer/supplier must provide recommended product support and maintenance to ensure that the system functions in an acceptable manner. Without such a basic level of support, customer goodwill can easily be lost. Product support and services can be described as including deeds, processes and performance (Zeithaml and Bitner, 2000). Deeds are activities that solve problems which customers can't solve independently. A service process is a strategy used to carry out the necessary deeds. Performance concerns how well the deeds are performed and encompasses service effectiveness and efficiency. Services can be used to increase productivity, to earn customer loyalty, to generate positive word-of-mouth advertising, and as a defense against price competition. They can be tangible or intangible. When analyzed over a time-spectrum, services and product support can be classified into three groups, namely: before, during, and after sale. Before and during sales services include advertisement, documentation, training, installation, etc. After sale can include elements such as warranty work, general service, provision of spare parts, expert assistance, online help, field service, and logistics support. Goffin (1999) asserts that after sale services and product support are important for manufacturers because they:

- can be a major source of revenue,
- are essential for achieving customer satisfaction,
- can provide a competitive advantage, and
- play a role in increasing the success rate of new products

Delivery of the required function means ensuring that the right product (meeting the requirements of quality, reliability and maintainability) is delivered in the right quantity, at the right time, in the right place, from the right source (a vendor who is reliable and will meet commitments in a timely fashion), with the right service (both before and after sale), and, finally, at the right price. The customer must perceive that these objectives occur simultaneously (Belev, 1993). In general, products can be classified by their characteristics into two groups, namely consumer products and industrial products. Consumer products can be PCs, TVs, foods, cars, etc. Product attributes such as style, fashion, appearance, etc. can be critical. Consumer products are typically used directly by customers who don't use the products for further production. Consumer products can be made to meet the needs of a wide range of customers. An industrial product's customer is typically an operation that may have special product criteria, specifications, standards etc. These products may be customized to more precisely fit an industrial customer's needs. Industrial products may be used for further production activities. Drilling machines, mining equipment, locomotives, oil platforms etc. are a few examples of industrial products. There exists a vast body of literature that describes different forms of services often required for

consumer products (see for example Grönroos, 2000; Grönroos, 1999; Edvardsson et al., 1994; and Zeithaml et al., 1990). Our literature survey found that there is a shortage of similar literature that deals with industrial production systems. The few exceptions include Andersson (2002) Goffin (1999), and Malhotra et al. (1994). Andersson (2002) discusses different categories of service suppliers and examines their service strategy in a multinational environment. Goffin (1999) describes the key elements of customer support using a number of case studies in different types of industries and, from his observations, presents descriptions of approaches that are likely to provide a high quality of product support for customers. Malhotra et al. (1994) compare the quality of service delivery in developing and developed countries and conclude that the quality of services (types of training) provided to customers in developing countries are inferior to those provided to customers in developed countries. Most of the literature relative to industrial products focuses on the purchasing behaviours of organizations; both purchasing of products or purchasing of services (see, for example, Baptista, 2001; Stremersch et al., 2001). Based on interviews with maintenance and service personnel Stremersch et al. (2001) present some of the most relevant factors that are used by mangers in evaluation of maintenance and service contracts. They also present a theoretical framework for a full service contract that focus on purchasing services contracts rather than service delivery performance. In this paper, we consider various factors that must be considered when developing the most suitable service delivery strategy for (industrial) customer. Our focus is on service delivery strategy performance and treats it as one of the most critical factors in the marketing of service contracts. We also present a conceptual framework based on our field experiences (see Markeset, 2003; Kumar and Ellingsen, 2000; Kumar, 1989) and on the basis of a study of existing literature (Ylipää, 2000). We consider not only product support but also customer support as key elements in the delivery process.

To provide good service and support, organizations and companies make plans that consider likely product needs and customer requirements. Such a plan is often called a service delivery strategy.

An organization without a service delivery strategy is comparable to a motorist trying to embark upon an unfamiliar journey without using a map. The motorist should, even before starting to plan their route, be certain of their ultimate destination. Likewise, before beginning the strategic planning process for delivering services, an organization needs to answer fundamental questions such as what is to be achieved in terms of services, what is to be delivered, what is the customer capability, and how to fulfill the goal. Thus, a service delivery strategy can be defined as a generic overall plan for the achievement of service goals that also considers elements that may affect goal achievement.

Service delivery strategy (SDS)

In the past, when developing a service delivery strategy, original equipment manufacturers (OEM) focused on product design characteristics and paid little attention to the capacities of end users (Bailey, 1996). Too, when service programs were developed they were similar throughout a product line. Designers were generally unaware of the needs of potential customers. Focus was on product and use strategy; a "product-centered" approach. This type of strategic thinking did not consider customer capability, customer organizational culture values, customer corporate strategies, etc. However, a focus on the needs of potential users should always be emphasized, as there is a human tendency to "forget" users during the design process. Importantly, a service delivery strategy that does not consider potential customer patterns, needs or backgrounds is outdated and bound to be ineffective as it fails to include critical factors that influence service success. Consideration of customer patterns, values, strategies, operating environments and maintenance policies represents a "user-centered" approach that fosters development and implementation of effective service delivery strategies. Equally apparent is that "human factors" is no longer an area normally left to specialists; all staff working on product and service design issues must consider customer needs and customer workforce capacities when developing, designing, planning, and implementing (Rubin, 1994).

Strategy can be divided into two groups, namely: functional strategy and organizational strategy. Functional strategy includes operations, human resources, marketing, finance, information technology, and logistics considerations. It must be appropriate for the organization concerned. Organizational strategy normally consists of corporate strategy, corporate planning, business strategy, business policy, and strategy management. Together, all of these make up a long-term plan for the organization. Each organizational unit must have its own business strategy that matches the operating environment and markets (Hope and Mühlemann, 1997). When a unit or organization is developing service delivery strategies, important issues such as product design characteristics, operating conditions, and customer-operating requirements must be factored into the planning process and when defining product support and service requirements. If these elements are not considered in depth, the service delivery strategy may not fulfill the product's functional requirements. Figure 1 describes the relationship between these elements and the resulting product support requirements. Service delivery strategy is shown in the figure as being dependent on product support and service requirements (PSSR). Reliability and Maintainability (R&M) characteristics, operating environments and customer operational requirements directly shape PSSR and, through it, indirectly influence the Service Delivery Strategy.

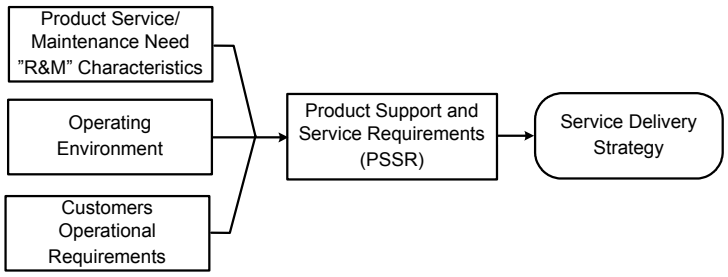

Figure 1 A simple model for service delivery strategy

Reliability & maintainability characteristics

A major part of any system's operating costs are due to unplanned system stoppages for unscheduled repair of the entire system or of components. The single most important factor that influences the incidence rate of unplanned repairs is the designed reliability of a system or component. Lower reliability generally leads to more failures, which then leads to an increase in unplanned repairs and decreased system availability. This, in turn, increases production costs. The different phases of an equipment/system life cycle can be represented by the well-known 'bath-tub' curve (see Figure 2). This curve depicts a typical relatively high failure rate during the early part of any equipment life cycle. Advisable to plan for is extra product support designed to address teething problems in this part of the life cycle. Here, support to a customer is critical; particularly for a new line of products. Early life cycle problems are often due to failures in design, incorrect installation, operation by poorly trained operators, etc. This period is often referred to as the "burn-in" phase. The next stage of the cycle is called the "useful life" phase of the system and it is often characterized by a predictable and constant failure rate. When earlier planning, development, and service have been successful, this phase has no unscheduled repairs and service/maintenance needs are minimal. The third stage of the system life cycle is characterized by the "wear out" phase where the failure rate typically increases and, in turn, there is a need for more service and maintenance. Thus, we see that reliability is the most critical failure rate determinant. A clear understanding of reliability can then be used to predict and determine life cycle service needs. Knowledge of components and system reliability becomes critical when deciding upon a service delivery strategy. The reliability characteristic is commonly measured as the mean time between system or component failures or the mean time to failures (see Blanchard et al., 1995; Dhillon, 1999).

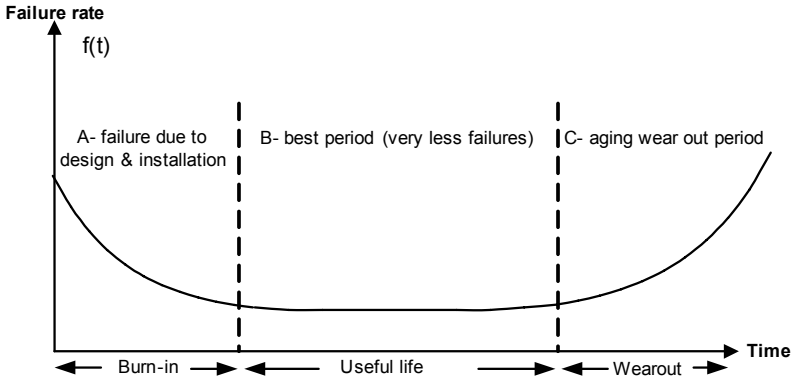

Figure 2 The bathtub curve

In addition to reliability, careful attention to maintainability characteristics is necessary when planning a service delivery strategy. Here, the goal of maintainability is to make certain that all maintenance tasks can be carried out by the minimum number of people, in the shortest time, and at the lowest cost with simple tools. High maintainability performance means that a system is simple to maintain and repair after failure. Maintainability is usually measured by the mean repair time (often called Mean Time to Repair - MTTR), which includes the total time for fault finding, and the actual time needed to carry out repair. Blanchard et al. (1995), Dhillon (1999), and Dummer & Winton (1990) contain more detailed descriptions of this concept. Good design for maintainability is critical as any maintenance activity adds to non-availability time. Systems with superior maintainability have features designed into them that facilitate part/component interchangeability, provide easy accessibility, are easy to service, and are modular in design. Thus, we can say that reliability and maintainability (R&M) characteristics highly influence a system's service delivery strategy.

Operating environment

Operating in an adverse environment (e.g. climate or user characteristics) often influences the reliability of a system and its components. An adverse environment typically causes increases in failure rates and, in turn, a need for enhanced service and maintenance preparedness. For instance, if a product is used in a corrosive environment there will be a greater demand for service and maintenance. In such a scenario, a strategy for product support that compensates for the increased maintenance needs must be developed and implemented. Climatic and operating conditions also have considerable influence on service facility and tool design. Consideration of such factors during service delivery planning will improve the

effectiveness and efficiency of actual service delivery and likely result in a higher level of customer satisfaction.

Therefore, if environmental factors are not clearly identified and well defined then the development of an effective and efficient service delivery strategy is impossible as necessary information is absent. Instead, service delivery becomes a trial-and-error process during any operation where R&M characteristics are greatly influenced by the environment.

Customers' operational requirements

An understanding of customer requirements (system performance/availability requirements, production schedules, delivery schedules etc.) makes it possible to better define and optimize system service and maintenance planning. Service requirements and delivered services must be aligned effectively so as to meet both system and customer requirements.

By assessing the requirements of each customer using qualitative and quantitative data on their needs and wants, a clearer understanding of what is needed to gain maximum customer satisfaction is achieved. It is then more feasible to develop strategies that apply to all or most customers and at the same time identify special criteria unique to a few, or even one customer. This optimizes economy and efficiency through the use of commonly used service delivery strategies. At the same time, individual customers are satisfied, as their individual needs are not ignored. A manufacturer/supplier also adds to their reputation for dependability when special, activity-related needs of long-term customers are anticipated and supported (see Peppers and Rogers, 2001; Stremersch, et al., 2001). The truism being stated here is that an in-depth analysis of a customer's requirements and understanding of their organizational culture will reveal the type and level of service that a customer needs.

Thus, we can say that customer operational requirements contribute to the defining of the PSSR for a system and to the development of a service delivery strategy that accurately reflects customer needs and operating conditions.

Customers' maintenance strategy

For SDS it is important to understand a customer's business process particularly as it relates to the management of maintenance needs. Figure 3 illustrates the most common maintenance strategy adopted by industrial organizations for the management their maintenance processes. The approach can be divided into two major groups; namely strategies for:

1. *Planned Maintenance Tasks*: Work performed according to a scheduled plan, e.g. preventive maintenance. Maintenance planning involves planning when preventive maintenance is to be performed. It includes pre-planned and scheduled adjustments, major overhauls, inspections and lubrications that are designed to maintain equipment and facilities so that breakdowns and the need for emergency repairs are minimized.
2. *Unplanned Maintenance Tasks*: Maintenance is carried out when required and no prior planning is made. This strategy is commonly called "failure-based maintenance". Failure-based maintenance is the best policy as long as cost is either the same or less than what it would be if planned. This maintenance policy is suitable for non-repairable items or parts where their failure consequences are negligible. This approach is not economical when there is complex pieces of equipment whose failure will stop the operation of an entire system. Similarly, such policies are not cost-effective for integrated operating systems or mine automation where losses in production represent a large indirect cost.

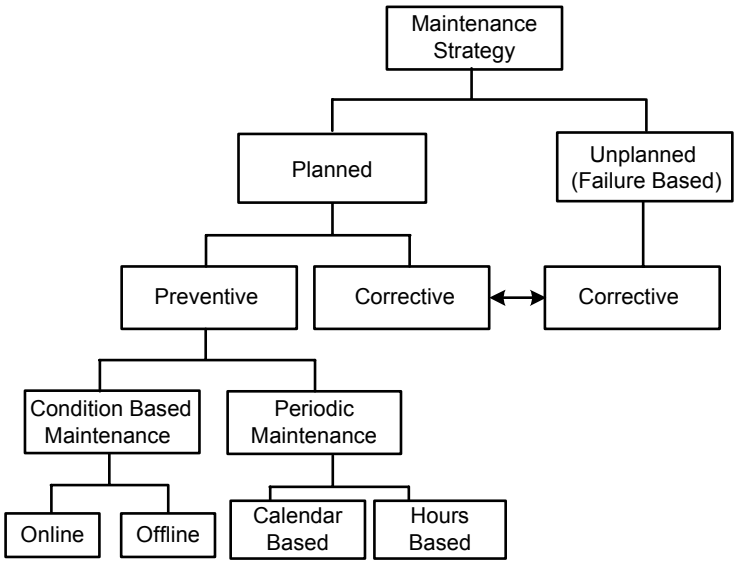

Figure 3 An illustration of different approaches to maintenance strategy

Depending upon their particular circumstances and needs, an organization may use planned and unplanned maintenance strategies. Which strategy is the most cost-effective in a particular situation being the determining factor. Other organizations

may have determined that one or the other strategy is most cost-effective and they use just one.

Other industrial customers prefer not to develop in-house maintenance organizations and competencies. Instead, they outsource maintenance either partially or completely. Normally they then enter into service level agreements with either original equipment manufacturers (OEM) or with companies specializing in service and maintenance. Often, industrial customers need services at strategic, tactical or operational levels to fulfill specific business objectives. Typical examples of such service contracts are:

- *Partial outsourcing or contracting out of specialized maintenance tasks*: Many companies prefer to have an in-house maintenance organization for better control of assets and availability. They also prefer to outsource maintenance tasks that require specialized knowledge or facilities. For example, in the oil and gas industry, subcontracting has been traditionally restricted to specialist equipment such as turbines, inspection of subset structures etc. Such contracts can be described as partial outsourcing and are a typical example of a service level agreement at the operational level. However, in recent times there has been a trend towards outsourcing of routine service and maintenance activities and, in many cases, management of service and maintenance processes either to original equipment manufacturers or to maintenance and service provider companies i.e. ABB service, SKF service, etc.

- *Outsourcing (full services contract)*: World-wide top management cost reduction initiatives have led to massive downsizing of workforces. The trend has been to focus on core business activities and to hire contractors to perform all non-core activities within the framework of an agreement. Such a trend creates great opportunities for customers and service providers. To create additional product value and to attract customers, many manufacturers are offering product support as a full-service package for a product's entire life cycle. Full-service can include up to all corrective, preventive and predictive maintenance activities at an entire production site. Multinational companies engaged in manufacturing of industrial products like ABB, SKF and Atlas Copco provide full-service contracts as part of their operations (Stremersch et al., 2001). The service level agreement leading to outsourcing of non-core activities can be an example of services at the tactical level.

- *Purchasing of function instead of product (functional products)*: In such a service level agreement, a strategic relationship is developed between service provider and customer that is characterized by the purchase of a functional product. In case of a functional product, the user buys the function, not the product (as opposed to conventional product purchase where the customer buys the product

and uses it). In this arrangement the customer is not responsible for system operation & maintenance (Markeset and Kumar, 2003). In this case, customers have access to a technology while not owning a machine. This approach may be extremely cost-effective as a customer neither invests capital nor plans for operation and maintenance. Some machines are costly and specialized; upon completion of specialized work they can tie-up capital (money), have no immediate functional value, and still require maintenance or other fixed costs (an ongoing cost, giving no return). In the case of function purchase, product manufacturers are responsible for operations and maintenance. They typically have a high confidence in their capacity to control cost as their workers understand the system and share a common organizational culture; irrespective of work-site location. . With this strategy, the user company focuses on a core business processes (e.g. production) and need not make any investment in operations & maintenance. Both parties (supplier and customer), in effect, share business risks. In general, a functional product purchase support strategy is different than for a conventional product purchase support strategy (see Markeset and Kumar, 2003).

In today's competitive marketplace equipment and systems users tend to operate around the clock and are not willing to provide time slots for preventive maintenance. If not managed properly this can lead to a steep increase in unplanned tasks and raise operations and maintenance costs to over amounts allocated. To deal with this type of situation, many customers (if they are doing the maintenance themselves) or service providers often adopt an opportunity-based maintenance strategy. Preventive service and maintenance tasks are usually executed when production is halted for other reasons. This strategy requires careful planning and efficient deployment of maintenance resources by maintenance managers. In short, understanding of a customer's maintenance strategy is critical in the success of a service delivery strategy.

Supplier's own service delivery capability

Manufacturers/suppliers need to maintain a service organization capable of delivering parts and services to customers. Most manufacturers usually have a service department responsible for providing a range of follow-up support parts and services such as assistance in faultfinding, failure diagnosis, expert assistance, spare part delivery, and after-market sales. However, many manufacturing companies are uncomfortable with the intense service expectations of today's industries. Service departments usually function differently than other departments as customer relationships are usually of a longer duration; a more customer-oriented activity focus. This is in contrast to and sometimes in conflict with the short-term relationship and internally oriented outlook of the rest of an organization. A service department is

obligated to stay in contact with customers throughout a product's life span whereas the remainder of an organization has minimal customer contact after sale. When developing a service delivery strategy a service provider department has to analyze its own service delivery capability and the maintenance/service organization of the end user. A functional service delivery strategy must also examine/assess alliances and networks of service providers/workshops in different countries/regions. This may mean working with an isolated organizational unit with its own sub-culture or developing a relationship with an independent contractor who can provide cost-effective services in more remote areas.

Geographical location

When developing service delivery strategies for multinational environments a service provider must consider the geographical location of products and customers to be serviced. If products and customers are located in remote areas, extra resources that bring service and support up to a standard level may be needed. Transport availability and location become a critical element in the development of a competitive, yet cost-effective, service delivery strategy. Geographical location affects the system supply chain as it can increase logistics costs. Geographical location of the machine/system (distance to manufacturer/supplier), criticality and lead-time for spare parts delivery are examples of these factors (Ghodrati et al., 2003). Apart from infrastructure issues and added logistical costs, local rules and regulations may have a critical influence on the strategy development process as customary practices may not be permitted or they are heavily taxed. Just as different organizations may have different cultures; customers in different geographical regions may also be influenced by their regional cultures. Factors ranging from control design patterns to communication styles may differ and influence the potential success of a service delivery strategy. Storti (1999) provides an overview of cultural factors and discusses the ways they might influence a business process.

A conceptual framework for service delivery

Based on our field experience from a series of applied projects (see for example, Markeset, 2003), a literature survey, and a study of factors influencing (as discussed in previous sections) the service delivery process we developed a conceptual service delivery strategy framework as shown in Figure 4. This framework incorporates the different factors that typically influence a service delivery strategy. The service delivery strategy will differ for the same product when ownership is functional or conventional (Markeset and Kumar, 2003) and costs associated with the different strategies will be significantly different. The strategy for conventional products should take into account all the factors and aspects illustrated in Figure 4. With functional products, a customer is not responsible for maintenance so customer

maintenance strategy is not included in the framework (as depicted in Figure 4 by the box with broken lines).

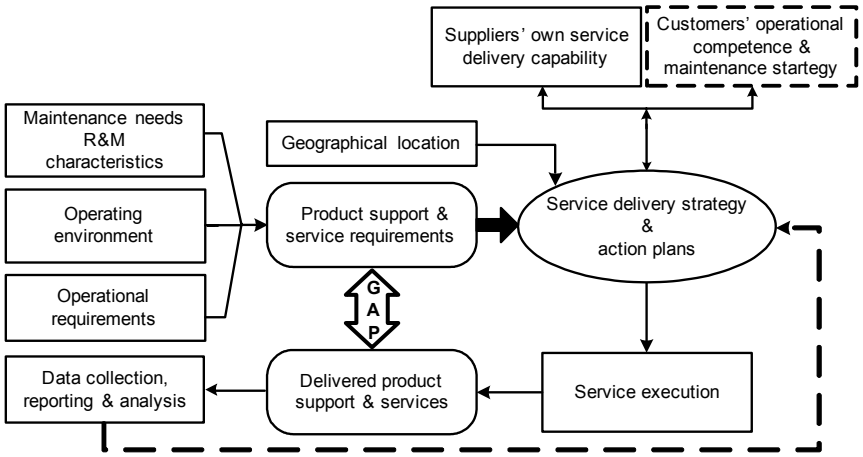

Figure 4 A conceptual framework for development of a service delivery strategy

The assessment of a service delivery strategy forms an integral part of a service delivery strategy implementation process. For effective evaluation of service performance, the service delivery strategy must have a provision for collection of performance data for analysis and feedback.

Service delivery performance evaluation

A comprehensive evaluation creates an awareness of product support/service delivery strategy functionality. It identifies activities where improvements are needed as well as those strategies which have performed well. Customer satisfaction measures the service providers/manufacturers responsiveness, its ability effectively communicate with a customer, its technology (capabilities and products), and product quality/reliability. Any gap between PSSR, which facilitates customers' need & wants, and delivered service, must be eliminated.

Service gap model

Successful service providers are those who are able to zero the gap between required services and the services delivered. In real life it is not always easy to define "required services" as they are often influenced by subjective criteria. Customers may have different expectations regarding services than what is defined by the

manufacturer/supplier. To be successful, service providers have to be intelligent enough to integrate customer requirements and expectations into service delivery strategies. Figure 5 illustrates a modified service GAP model based on the work of Zeithaml and Bitner (2000). The broken line box in Figure 5 illustrates Zeithaml and Bitners' original gap model. The modified model presented here adds to the original model by including the assessment of any difference between required and delivered product support/services. In this model the major causes for gaps in service delivery can be attributed to

- not dimensioning the service correctly as per customer requirements; and
- not integrating customer requirements into a service delivery strategy (as discussed in previous section).

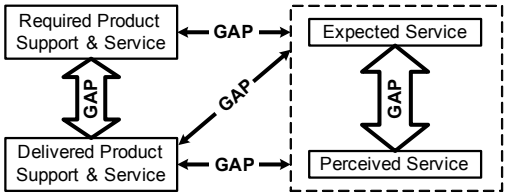

Figure 5 Modified product support and service GAP model

Mathieu (2001) thoroughly discusses the reasons behind why a service delivery strategy should focus on developing means to support customer needs and expectations and emphasizes without an adequate consideration of customer support needs any real or potential service gap cannot be bridged. Pointed out is that when a supplier effectively considers customer requirements and organizational goal(s) that the likelihood of a service gap is minimized. A key concept is that a successful service provider develops a service delivery strategy which achieves its own organizational goal(s) while simultaneously satisfying the customer's goal(s). With this approach, it is the responsibility of the supplier to reduce the gap and satisfy the customer. From a pragmatic perspective, non-matching of performance to promises made will likely lead to customer dissatisfaction and ultimately the loss of business. As mentioned earlier, a service delivery strategy needs to be developed that considers each product's designed characteristics along with customer special needs, wants, and preferences (Markeset and Kumar, 2002). The integration of customer needs and requirements into the product design and development process as well as into the service delivery strategy development process is essential if potential gaps illustrated in Figure 5 are to be avoided or minimized. The outcome being that the customer believes that all needs are adequately and economically supported.

A performance evaluation indicates the degree to which a goal or objective has been achieved. Indicators depend on data collection/reporting and clear descriptions

of company targets/goals. Indicators are classified into two types: lagging indicators (outcome measures) and leading indicators (service performance drivers). A good linkage between lagging and leading indicators makes it possible to control the performance of services to be delivered. It can be difficult to track down the root of a problem in a service delivery process if indicators are developed solely for use at a senior management level. Some problems are minor yet can be (or later become) very important; often they cannot be detected by a management level indicator. It is therefore necessary that more detailed, critical leading indicators (performance drivers) are developed and implemented for use at the maintenance task management and task execution level. However, a clear link between a leading indicator (maintenance performance drivers) and a lagging indicator (outcome measures) is absent in indicators used at the senior management level then overall performance control can be a difficult task (Kumar & Ellingsen, 2000).

Managerial implications and concluding remarks

An effective service delivery strategy can help customers to achieve high system integrity and, in turn, lead to achievement of world-class performance and a reduction in business risk. Good services assist a customer in building up skills and competencies within their organization for optimal product exploitation. This ultimately means a higher return on investment (ROI) leading to strengthened customer satisfaction. For a service provider greater customer satisfaction can lead to customer purchase of new or expanded long-term service and maintenance contracts; an additional source of revenue. However, service providers should only facilitate the purchasing process and avoid selling services. Customers like to buy something not being sold and if this feeling is not respected it may result in a disgruntled customer (see Bosworth, 1995).

Providing product support and service to industrial systems is different from provision of product support and service to users of consumer products. Users of industrial products are more active in demanding services and they interact more closely with service providers. A user of industrial products has a greater need for support due to the nature of product use (e.g. continuously at maximum capability). When seeking to gain competitive advantages in industrial system service businesses, providers of product support and service must go beyond considering basic product operation, designed characteristics and pay equal attention to customer organizational cultures and values.

In this paper we have presented a conceptual framework for service delivery strategy development and implementation that considers product characteristics and customer operational/organizational features. This framework integrates customer requirements into a strategy development process and thereby helps to avoid or

minimize differences between customer service delivery expectations and perceived service delivery. An approach for measurement of service delivery performance is outlined as a way to assist in the monitoring a service delivery strategy and its implementation.

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Paper III

Kumar, R., Markeset, T. and Kumar, U. (2004), "Maintenance of machinery: negotiating service contracts in business-to-business marketing"

International Journal of Service Industry Management, Vol. 15 No. 4, pp. 400-413.

Maintenance of machinery: negotiating service contracts in business-to-business marketing

Rajesh Kumar[a], Tore Markeset[b] and Uday Kumar[a]
[a]Luleå University of Technology, Luleå, Sweden
[b]Stavanger University College, Stavanger, Norway

Abstract

As industrial products are becoming more advanced and complex, the role of supporting services needed to exploit a product's function to an agreeable performance is becoming increasingly important. To achieve the best performance, industrial customers are entering into service contracts with the original equipment manufacturers (OEM) or independent service providers. This, in turn essentially involves service contract negotiation between OEM/service provider and the client. If such contracts are not negotiated carefully, it may lead to conflict and poor system performance. Thus, a negotiation process plays a vital role in developing effective, efficient, and competitive service delivery strategies that ensures customer satisfaction. To achieve a win-win situation for both parties, a negotiation process must take into account all factors that influence the service requirement for the client as well the service delivery process. Aspects such as what services to deliver, who is to deliver them, how they are to be delivered and received, and at which performance level, need to be considered in the negotiation process and agreed upon by both the provider and the client. A conceptual framework has been developed for service delivery negotiation process based on review of literature and analysis of results from a survey conducted to study the existing approaches being practiced by the industrial organizations to negotiate a service contract.

Keywords: Industrial products, negotiation process, service delivery agreement, outsourcing, service delivery measurement

Introduction and background

Most firms engaged in manufacturing of advanced, integrated and automated durable industrial products such as production line equipment (e.g. robots), mining industry equipment (e.g. drilling machines), offshore oil production equipment (e.g. compressors and turbines), etc., provide support services. Traditionally, product support has focused on maintenance and repair issues such as delivery of spare/warranty parts, expert assistance, and field service. However, customers buying advanced and complex products may also need many other support services. Many companies are offering new, better, and more advanced support services than earlier (see e.g. Stremersch et. al., 2001; Mathieu, 2001; Goffin, 1999, and Bosworth, 1995). In many cases, the support services are needed throughout a product's life. Such services are often in literature referred to as after-sales services, product support, customer support, or just support. Goffin (1999) asserts that after-sales service/product support is important for manufacturers because it can be a major source of revenue as well as an essential element in the achievement of customer satisfaction. Excellent service can also provide a competitive advantage and can play an important role in increasing the success rate of a new product.

The total product received by the customer contains more than just the physical, tangible product, spare parts, documentation, and maintenance tools. It also includes services intended to support the product (e.g. spare/warranty parts, maintenance tools) as well as services intended to support the customer in utilizing the product (see also Mathieu, 2001; Markeset and Kumar, 2003a, and Kumar and Kumar, 2004). Services to support products are provided to overcome product weaknesses impossible to design out because of design constraints such as cost and state of the art technology. Maintenance, including services such as lubrication, filter change, and cleaning, etc., is therefore needed to retain or restore a product to an acceptable operating state. Typical examples of services directed at supporting the customer in enhancing product utilization include:

- Assisting the customer in defining product specifications, so that they accurately reflect what is needed or preferred
- Assisting the customer during the installation and commissioning phase of a product/system in installing, adjusting and priming a product for operation
- Assisting in defining the operational strategy which best fits with the rest of the operation where a product is to be used
- Providing advanced training and assisting in performance evaluation
- Undertaking utilization analysis and application assistance
- Providing field service
- Providing expert assistance for at site diagnostics and repair
- Providing remote diagnostics

- Making available help-desks, online help, and telephone support for fast and efficient problem resolution
- Assisting in optimizing logistics support
- Evaluating and assisting in retiring/disposing of a product at the end of its life

These services create additional value for both customers and provider alike. A successful service provider or manufacturer should be very anxious to create win-win situation in their market(s). A prudent service provider will adopt those broad strategies that go beyond sales to create incentives that foster customer satisfaction and retention. Success is more likely if the delivered services anticipate and fulfill customer requirements/needs, wants and preferences (see also Berry et al., 1988; Zeithaml and Bitner, 2000, and Grönroos, 2000).

To develop a competitive and effective service delivery process, it is necessary to define and analyze the support needs of the product and the customer. This has to be done in cooperation with users/customers. A negotiated agreement facilitates and helps a service provider/OEM (Original Equipment Manufacturer) to define when, where, how and in what form services need to be delivered. A negotiation process starts when two parties (e.g. a service provider/original equipment manufacturer and a user/customer) are prepared to make an exchange to mutual advantage. The objective of a negotiation is to reach an agreement in mutual interest and to the satisfaction of all parties involved. Negotiation has typically been described as a form of decision-making that occurs under conditions of mutual interdependence (Appelbaum, et al. 1999).

There exists much literature that emphasizes the importance of specifying customer's needs with respect to e.g. functional, operational and maintenance characteristics, delivery time, price, and so on (see for example Blanchard and Fabrycki, 1997, and Goffin, 1999, for an overview of literature). We have however, not found much literature emphasizing the need of specifying what kind of support services are needed for the product, how they are to be delivered, when they should be decided upon, and how the quality of the industrial supporting service product should be assessed. Because the service content and service delivery are heavily influenced of characteristics related to product, customer, and location (see Markeset, 2003), we in this paper will discuss key factors that define the needs for product support and services, key factors influencing the delivery of such services, and key content of a service delivery agreement. Based on a finding from a literature review and the survey conducted to study the elements of existing service contract negotiation process a framework for negotiation process is developed.

Scope of a service delivery agreement

We negotiate for predictable products and services. However, it is advisable also to consider services that are required due to occurrence of unpredictable failures and unforeseen events. Unpredictable failures require corrective maintenance and often unplanned product support. If corrective maintenance is required during a warranty period, it imposes losses for both parties. Outside the warranty period, the manufacturer will profit from selling spare parts on short notice while the customer will have losses due to unplanned maintenance, logistics, and administrative costs as well as production losses.

Services that support a customer are also related to product exploitation, capabilities of operational/maintenance personnel, production capacities, etc. A manufacturer can as a specialist on its own products, also offer support through for example advice to optimize product operation and maintenance performance. The need for this kind of support will vary among customers according to operating conditions, capability, capacity, and preferences. Many of the services to support a customer's actions in relation to a product can be planned. However, in a fast changing market it would be impossible to plan for all possible scenarios. Therefore, both parties must be prepared to deal with those situations that are fundamentally unpredictable and unknown (Markeset and Kumar, 2003b). This brings in the negotiation of service contingencies into the negotiation process.

Services to support the product therefore can be divided into planned and unplanned services according to failure predictability. In the following, we will discuss planned and unplanned services. Services related to warranty issues will be discussed in a separate paragraph because they are both planned and unplanned and most often are effective for only a part of the product's service life.

Planned services

Planned services (e.g. planned repairs, replacements, adjustments, lubrication, system monitoring, spare part logistics, maintenance tools/facilities, training, etc.) involve all activities that contribute to the avoidance of unexpected failures, handling of unplanned stoppages, as well as performance improvements. They can also include possible product upgrades and/or modifications, supplementary services such as product exploitation efficiency and productivity measurements, advanced training of operation/maintenance personnel, evaluation of operation and maintenance strategies, as well as assessing the service delivery process. Planned maintenance services like oil change or filter change are performed according to a scheduled plan. This plan is often based on a manufacturer's recommended preventive maintenance strategy aimed at activities to prevent breakdowns and increase system availability. Whilst planned maintenance services and preventive maintenance policies reduces the

number of failures, its may not offset reductions in unplanned services and corrective maintenance costs (Löfsten, 1999). It provides a critical service function without which major operations interruptions would take place (Mirghani, 2001).

Unplanned services

For unpredictable product failures resulting in corrective maintenance, there has to be a plan and contingency that addresses the possibility of such an unplanned events. This means that, if a product fails in an unexpected manner, all affected parties should be ready to resolve the problem effectively and efficiently at a minimum cost with a minimum loss of profit. A plan for dealing with unplanned situations should be discussed at the time of negotiation to avoid conflicts between service providers and customers.

During the negotiation of a service delivery agreement issues beyond anyone's control (e.g. earthquake, fire, flood, etc. – in general often referred to as "Acts of God") need to be considered. It is essential to outline clear-cut responsibilities and to create plans in the agreement to reduce stressful conflicts. This will help to ensure a long and healthy relationship between suppliers and customers.

Warranty services

A negotiation of an agreement for delivering support services must also consider warranty services. Even though the warranty service is planned, it is based on calculation of probability of failures. In such a calculation, the manufacturer assesses that there is a reasonably high chance that failures causing corrective maintenance will not occur within a limited period, called warranty period. Since downtime, losses normally are not covered in the warranty, events causing warranty claims results in a loss for both parties. Hence, warranty service terms and coverage period should be discussed in the negotiation process. Both terms and coverage should be precisely and clearly defined in the final agreement to minimize the possibility of future conflicts.

Warranty services are becoming more important as customers/users have started demanding protection against unsatisfactory performance and high system failure costs that occur shortly after purchase. A warranty is a manufacturer's assurance to a customer/user that a product or service is or shall be as specified. In general, two types of warranties exist, expressed and implied (Kuo and Wilson, 2001). Implied warranties are not part of an agreement and exist in governmental legislation and regulations. Expressed warranties are those that are agreed upon by the both parties and put in writing as part of a contract. The warranty assures a customer/user that a manufacturer will either repair or replace items that do not perform satisfactorily, or refund a fraction of cost. Offering a warranty represents a potential additional cost of servicing any problems that arise during a warranty period to a manufacturer. The warranty is intended to assure a buyer that a product will perform its intended

function under normal conditions of use, for a specified period. In addition, a customer/user will use a warranty as a means for rectify if an item, when properly used, fails to perform as intended or as specified by its manufacturer/seller. The warranty assures a customer that a faulty item will either be repaired or replaced at no cost or at a reduced cost. For a manufacturer/service provider a warranty is promotional since a manufacturer is often selling a more reliable product when a longer warranty is offered. A warranty has been used as an effective advertising tool. In addition, a warranty has become an instrument, similar to product performance and price, used in competition with other manufacturers in a marketplace.

In addition, some customer may believe that if something happens to a product during a warranty period the manufacturer will repair or replace it free of cost, no matter how the product is used. Manufacturers therefore are concerned about, and try to guard against, situations where a user misuses a product/system. Depending on replacement cost, manufacturers may monitor use to discourage abuses.

Thus, in a service delivery negotiation process, many issues must be discussed regarding warranty services. If warranty services are not considered in-depth, future system failures or user dissatisfaction can create conflicts between the parties (for more detail see, Blischke and Murthy, 2000; Kulkarni, et. al., 2002; Nguyen and Murthy, 1984, and Chattopadhyay and Murthy, 2000).

Key influencing factors for dimensioning of service delivery process

The global marketplace requires the development of a manufacturing system that begins with the understanding customer requirements (Richard and Pearson, 2001). Once an OEM/service provider understands the customer's requirements, it becomes easier to communicate and convey true messages in a service delivery negotiation process. Hence, before starting the process for a service delivery agreement, various aspects of the product and the customer need to be identified and understood. These may influence both the supporting service content, the actual service delivery, as well as the negotiation of the service delivery agreement.

Product characteristics

Since the products discussed in this paper often are used in for example production lines or in other applications where downtime costs are significant or critical, the customers often have technical requirements of high efficiency and uptime, excellent output quality, as well as low operational and maintenance costs. A product's downtime is a function of how easy, safe and economic it is to perform maintenance, how effective the administrative routines are for scheduling, planning,

and executing maintenance, as well as availability of spare parts, expert assistance, repair tools, etc. Uptime is measured by availability, and depends on the system's reliability and maintainability characteristics, as well as an effective and efficient operational and maintenance support system (supportability) as shown in Figure 1.

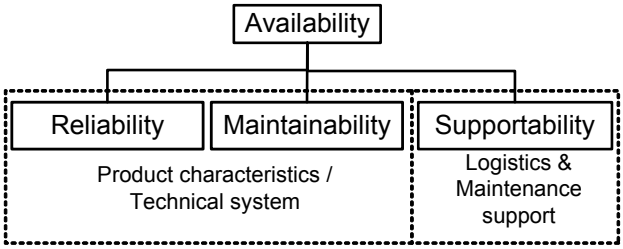

Figure 1 Elements of system availability

Reliability is a measure of how often the system fails and is influenced by its component's quality, tolerances, stress and load, use environment, system assembly, system configuration, handling, and so on. Lower reliability generally reflects increased probability of system/component failure rates. This leads to an increased probability for unplanned repairs and reduced system operational availability. Failure rates of components, therefore, play an important role in defining the reliability of a system. If failure is instantaneous, spare parts are required to be kept ready for use to reduce downtime.

Maintainability is a measure that reflects how easy, accurate, effective, efficient, and safe the maintenance actions related to the product can be performed. High maintainability reflects the probability that all maintenance tasks safely can be carried out by the minimum number of people, in the shortest time, and at the lowest cost with the simplest tools. If a system has a high maintainability, failure indication/diagnostics and failure localization is easier, parts are accessible and easy to replace or repair. The reliability and maintainability characteristics define the technical specifications that relate to service and maintenance requirements.

Supportability is a measure of how easy, cost effective, and safe, it is to support the product (e.g. logistics support and maintenance support). Logistics and support will greatly influence the cost of maintenance and services. A logistic support system analysis must offer certitude that system requirements can be fulfilled. An in-depth analysis of supportability requirements is critical for arriving at true maintenance /support costs. In general, it is not possible to define requirements of supportability without having a good idea about costs that will satisfy customer's requirements.

Thus, reliability and maintainability (R&M) analysis and a logistic support analysis must be performed simultaneously and iteratively. We know that availability

of a system depends on its reliability, maintainability and supportability. Hence, these parameters have to be considered in-depth in a negotiation process (see for example Blanchard and Fabrycki, 1997).

Operational requirements and operating environment

Whether realized or not, operational requirements and operating environment influences customer requirements with respect to supporting services. Operational requirements define the load and stress on a product (e.g. hours per day, utilization load). The environment where the product is going to be used can vary immensely and will clearly affect product operations, maintenance and supporting services. Parameters such as temperature, humidity, corrosiveness, dust, etc., all affect product durability. For example, an adverse environment typically causes increases in failure rates, and in turn, a need for enhanced service and maintenance preparedness. In other words, in this case the customer requirements for maintenance and product support will increase. Wear, tear, and deterioration, and hence the type of support needed, changes according to the interaction between design characteristics and the harshness of intended operating conditions.

Customer's capabilities/ resources and preferences

Many of the customers are realizing that potential profit is lost in ineffective and inefficient product utilization. Especially in this area, many customers have a large potential of benefiting from taking advantage of the manufacturer's/service provider's specialized knowledge obtained through product delivery and interface with many different customers. The manufacturer can provide services such as expert assistance, advanced training, develop specialized operational, maintenance and support, improved documentation, and so on. All these services may be used to both parties' benefit. However, the need for such services will vary among customers dependent on their own capabilities, resources, and preferences. See Kumar and Kumar, 2004 and Markeset, 2003 for further discussion.

Infrastructure

The location and environment where a product is to be used will not only influence its product technical characteristics, but also the delivery of support services. If a manufacturer and their customers are located in different parts of the world or in remote areas, extra resources need to be provided to achieve the same level of support as compared to those located closer to the provider. Whether the infrastructure in the customer's area allows for faster and more convenient distribution, delivery, communication, etc. is important. Apart from infrastructure, issues such as local legislation, rules and regulations, political issues, and other unique aspects must be discussed.

Available competence

How a product is operated and maintained may also be influenced by competence and skills of the personnel. Availability of personnel with the needed competence varies for different countries and regions of the world. Lack of the right level of competence can therefore dictate what kinds of services will be needed from the OEM/service provider – both with respect to services to support a product as well as services to support customers. For more details, see Malhotra et al., 1994.

Price

Some service providers offer fixed service rates that not only dependent on price, but also on what service is provided (e.g. telephone support at an hourly rate or fixed annual price). Every customer naturally wants maximum benefits from a purchased product – including services. The service supplier evaluates competitive conditions to ensure competitive prices. Both parties want a product that should have the lowest possible life cycle cost and generate maximum possible life cycle profit. In order to decide price, the service provider needs to have an indication of the customer's budget (Kuo and Wilson, 2001). Usually users/customers are extremely anxious to fix price of the services or system at the lowest level (Dobbins and Pettman, 1997).

With respect to pricing methods, prices are considered as mark-up prices and target return prices; both cost-based. An acceptable industrial product price is dependent on the budget or the economic condition of a customer's organization. Different rates can be charged for products depending on who a buyer is, quantity, time, place, type of maintenance/service, and duration (Morris, 1989). Pricing not only serves a promotional purpose, it also contributes to the efficient use of service capacity. Prices are a variable component of the organization's overall marketing strategy.

Interface between service provider and customer

Practical aspects of delivering services naturally influence the quality of service. Hence, the quality of a process is dependent on the interfaces between the parties involved. Since the service delivery interface serves as the foundation for a relationship between a service provider and receiver, it needs to be considered when negotiating the service delivery agreement.

Presently, some companies outsource their service and maintenance functions/requirements directly to the OEM as shown in Figure 2, as a way to focus on core business values and thereby minimize business risk, and to increase competitiveness. In a scenario where an OEM and their customers are located in different countries or at great geographical distance, the manufacturer needs to know the customer's cultures, organizational goals, etc. A second alternative scenario would

be to contract out/outsource to a regional/dependent service provider (authorized by OEM) who understands the cultures, knows the product well, and can effectively work as an extended arm of the OEM. In this case, it would be relatively easy to dimension product support requirements and develop a service delivery strategy for the product. In a third scenario, a customer chooses to outsource service to an independent service provider. The independent service provider would still have to obtain spare parts for the product as well as expert assistance from a manufacturer.

As shown in Figure 2 the interaction and interface between the OEM and customer can be direct (1) or indirect (2 and 3). Due to geographical location and distance, services to support an advanced industrial product are often outsourced to a third party related to the manufacturer, e.g. a regional office, or an independent supplier chosen by the customer. If the customer chooses an independent provider, this provider can choose if spare parts and expert assistance should be purchased from the OEM or elsewhere. However, some products require spare parts from the OEM or from a company to which the OEM has licensed the service production (including spare parts). The interface between the service process partners therefore needs to be considered during a negotiation process.

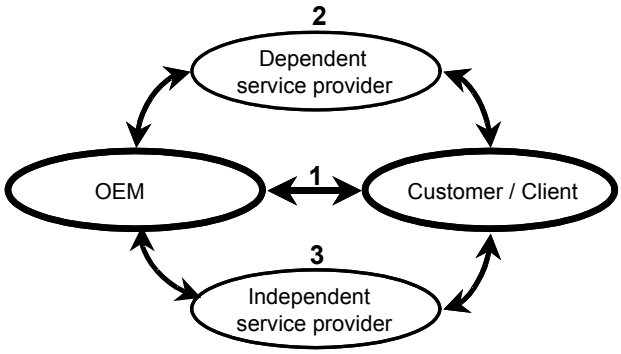

Figure 2 Possible service delivery interfaces

If information is shared freely, there should be a minimal business risk for the manufacturer and customer. If the independent provider is not familiar with the product requirements, a customer or a manufacturer risks may be greatly increased. In addition, if an independent service provider chooses to acquire spare parts, expert advice, etc. elsewhere, the risk of product failure may also be higher. This may reflect back on the manufacturer in the form of reduced goodwill and dissatisfaction. Hence, outcome and result from the performed service should be clearly defined during a negotiation process.

An OEM/service provider must develop a specialized service delivery strategy for each customer based on a general service delivery strategy for all customers. Similarly, the customer must develop a specialized service reception strategy based on a general service reception strategy. An alignment between these two strategies is required to achieve success in the market, minimize operating costs, and to maximize profitability (see for more detail Markeset and Kumar, 2003b)

Cultural aspects

Cultural differences impact on behavior towards and understanding of a customer and all interactions between a customer and service provider (see e.g. Wilson et al. 1999). It may cause participants to view issues quite differently or place different values on social interactions inherent in service delivery and negotiation processes. Different cultural systems may have divergent negotiating styles – ones that are shaped by a culture, language, geographical location, history, and political system.

When delivering services across cultures, statutory requirements used in one country may not apply in another. Therefore, an OEM/service provider must improve its knowledge about a customer, understand the customer's culture, and must be ready to devote time and effort to a service delivery process. To succeed internationally, an organization has to develop and practice a successful and cross-cultural service delivery skills. In a cross cultural context, two business partners could be separated from each other by totally different languages and culturally-based business etiquettes, and also by different ways of perceiving the world, of defining business goals, of expressing feelings, and of showing or hiding motivation and interests (Gulbro and Herbig, 1999). For further details see Herbig and Kramer, 1992; Gulbro and Herbig, 1995; Martin and Herbig, 1997, and Zarkada and Fraser, 2001. Ignorance of cultural differences may lead to conflicts as well as loss of business and customers.

To study industrial practices, key content and factors influencing a negotiation process, a survey in the form of a questionnaire was prepared for service providers and client companies in Norway.

Survey of existing practices in industry

The main purpose of the survey was to assess content and the influencing factors needed for negotiating a successful agreement and a win-win situation for both parties. The target group for this survey was senior managers involved in product support and service delivery contract negotiations. An effort was also made to contact target managers by telephone for discussions and to obtain deeper insight into the negotiation process.

The questionnaires were divided into two parts. The first part contained an open-ended type of questions and the second part contained multiple-choice questions. The

questionnaires dealt the following areas: key content of a service delivery negotiation process, factors influencing the negotiation process, timing of the negotiation process, duration of service delivery contract, and service agreement follow-up. The questionnaire was sent out to 20 Norwegian companies involved in manufacturing and service of industrial products, and companies that are buyers of such products. We received nine replies. The responses were used to elaborate on the issues from literature and bring our treatment of the topic closer to actual practices. The results from the different survey areas are described below.

Key contents in a service delivery negotiation process

Based on the questionnaire and interviews, we found that there are several key elements in any service delivery contract negotiation. The manufactures keep the main focus on the service goals and scope of work, payment terms, maintenance goals, and organizational goals. A customer on the other hand, focuses on price and delivery time of service, spare parts, etc. Some companies consider product reliability as a key part in service delivery negotiation. The key elements of a service negotiation process are listed below:

- Goals and scope of work
- Payment terms
- Product reliability
- Price
- Training and documentation
- Overhaul and maintenance mission
- Spare parts management
- Operational requirements

The survey shows that most of the companies share the same key items. A notable exception was the aviation industry where the main focus is on safety. Most of the companies do not emphasize maintainability. However, most of the OEM's were aware of the influence of RAMS (reliability, availability, maintainability, supportability) characteristics on dimensioning product support.

The survey indicated that each factor has a separate influence on the service delivery content. In addition to these factors, types of services (e.g. planned, unplanned, warranty services etc) needed to be defined during the negotiations. Most of companies recognized that it is also necessary to consider not only product reliability, but also product maintainability. This was because they tended to believe that reliability defines product tolerances, and maintainability defines resources required for service delivery.

Factors influencing the negotiation process

The answers obtained from the survey indicated that the manufacturing companies/service providers focus on geographical location, operational requirements, and other factors listed below, whilst the customer companies listed product history and reputation as well as producer reputation (manufacturers/service provider) as important. They were also concerned about the type of services needed to prevent system downtime. In addition, some companies focused on competing products available in the market. The most common potential service delivery agreement conflict factors are:

- Geographical locations
- Availability of competitors
- Customer's own capabilities
- Service provider/manufacturer own capabilities

Factors that emerged as important to consider during the negotiation process were: customer organizational cultures and competence services, The OEM's own capabilities, government rules/regulations, and customer corporate strategy regarding purchasing of services or maintenance policies.

When to negotiate a service delivery agreement

For most of the companies, product support and delivery of services were negotiated before delivery of the product/system. One company addressed support/service needs after installation and during operation as needed. The survey indicates that customer companies tend to equally negotiate the supporting services at the time of purchase as well as during the system operational phase.

Based on the answers from the companies we concluded that the service delivery negotiation process should be carried out before selling a system. If the services are not defined during buying/selling process, misunderstandings are more likely to occur and lead to undesirable problems and/or loss of business.

Duration of a service delivery contract

Time duration for the negotiated agreement varies from one year to five years with a yearly review for price revisions and revisions concerning delivery scope. The survey indicates that the contract duration should not be too long (for example not more than five years), or too short (for example less than one year), dependent on type of product, price, market sensitivity, and other factors. Rapid changes in technology and market may for example cause unexpected conflicts between customers and service providers/manufacturers. Factors such as changing product price or product saturation in the market are two likely causes of conflicts. Too long contract duration can cause loss of business. On the other hand, short duration agreements are harmful

in the sense that meetings/negotiations can be costly and consume resources for both parties, and yet yield little benefits. However, on the other side, if the service delivery contracts are renegotiated too often, small failures and disappointments may be fresh in the mind of a customer and serve as a seed for conflicts even though in reality the failure event did not affect overall performance.

Service agreement follow-up

All the companies participating in the survey indicated that they assessed performance at contract end to check the success of negotiated agreements. The participating service delivery companies said that they carry out a performance measurement process by seeking feedback from customers, by measuring product downtime, and through assessment of expressed customer satisfaction. They also solicit feedback through meetings with customers and through interviews.

One OEM, a regional office of a major aircraft manufacturer, noted that assessment was by means of parameters established jointly by themselves, their suppliers/providers and the customer as per governing GTA (general terms of agreement). Due to the customer's (airlines) high revenue sensitivity, schedule compliance is a principal requirement. Safety is also a key factor as it is heavily regulated and monitored. Some of the performance measurement instruments used by the survey participants are:

- Feedback from customer (complaint/praise)
- Performance parameters established jointly by the manufacturer, the suppliers/providers and the customer as per the governing GTA. Due to the customer's (airlines') high revenue sensitivity, schedule compliance is principal; safety is extensively regulated
- Regular meetings
- System/product/equipment downtime measurements, and
- Customer satisfaction measurements

The participants of the study indicate that performance measurement of actual service delivery is essential to improve future performance.

Negotiation of service delivery agreements

It is clear from the discussion in previous sections and the survey that services to support the product and services to support the customer need to be negotiated. Furthermore, through the negotiation process it is possible to develop an effective service delivery strategy. However, to attain the best agreement and one that is functional, all possible influencing factors need to be considered and addressed. Figure 3 shows the desirable or undesirable inputs that influence a negotiation

process. It is important for both sides to remember that in a negotiation process there can be undesirable inputs such as wrong information that will later lead to conflicts and agreement failure.

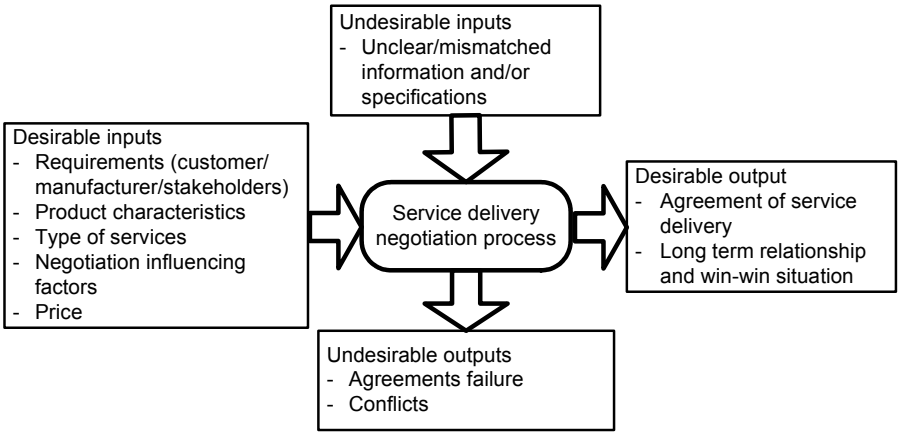

Figure 3 A conceptual framework for service delivery negotiation process

However, to ensure a long-term relationship based on customer satisfaction, both parties need to consider elements that influence the service delivery process. Hidden critical information may lead to a non-optimal service delivery and reception. Inputs include ascertaining customer and supplier requirements identified through discussion and clarifications in the negotiation process. If the negotiated agreement contains confusing and/or wrong specifications and information about what services are to be delivered and how they are to be delivered, the negotiation process will result in an agreement that will bring about service delivery failure and conflicts. Thus, one has to be very clear and transparent while negotiating for delivery of services, to ensure that both parties are satisfied with the support services and service delivery agreement.

The goal of the negotiation process is to arrive at an agreement in which both parties are satisfied with the outcome. As during the service delivery negotiation is impossible to predict all future situations and possible conflicts, both parties need to be prepared to renegotiate an agreement if the original agreement is unfeasible or fails. Potential conflicts caused by changes in the market may result in new capacity, capability, or quality demands. This may require product modification as well as changes in the support services delivery strategy.

Service follow-up and measurement of service delivery effectiveness

As a product and service performance is the basis for a relationship, both parties need to be open in dealing with new opportunities plus be willing to seek win-win solutions that reduce business risks and avoids conflicts. An instrument should be agreed upon to measure the outcome of service delivery to agree upon what constitutes conformance to negotiated service delivery agreement. In any process transforming something from an input to an output, one would want to measure the process performance with respect to efficiency, effectiveness, productivity, costs, etc. Hence, it is important for the parties involved to also include some kind of performance measurement for the service delivery process in the final negotiated agreement. This measurement system must not only reflect the customer's satisfaction with the service product, but also the manufacturer's satisfaction with the service delivery process. The manufacturer will for example benefit from the relationship not only in profit generation, but also in increase in knowledge, goodwill, and other intangible product. A typical example would be transfer of operational and service reception experiences back to the design engineer and the design/ manufacturing organization as well as to the service delivery organization. Such experience would be valuable both with respect to improving the product and the supporting service delivery process. To encourage excellent service delivery performance often bonus and penalty schemes are used. Both parties therefore have to agree upon the parameters for assessing product and service performance. Depending on feedback received, suitable amendment/modification/adjustment as per a negotiated contract can be taken.

Concluding remarks

In the process of negotiation a service delivery agreement both parties attempt to know each other and to understand the other's needs, wants, and preferences. A long-term and healthy relationship depends on that additional values are created for both parties. While safeguarding individual interests, it is equally important to avoid misunderstanding and conflicts. Ability to understand key contents and conflict causing elements of a service delivery process increases the chance of success. The negotiated agreement should describe key content, scope of the service agreement, responsibilities, as well as expected performance levels.

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Paper IV

Kumar, R and Markeset, T. (2005), "Development of performance-based service strategies for the O&G industry: a case study"

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Development of performance-based service strategies for the oil and gas industry: a case study

Rajesh Kumar and Tore Markeset
Centre for Maintenance and Asset Management
University of Stavanger
4036, Stavanger, Norway.
rajesh.kumar@uis.no

Abstract

Trends show that operators of complex oil and gas (O&G) production facilities are becoming increasingly dependent on service providers to support their efforts to perform according to demands. This is due to increasing demands for higher profit margins and cost reduction. This, together with increasing complexity of production equipment and increasing market competitiveness, is causing the facility operators to seek expertise and services outside their own organization. However, the development of strategies to deliver services at a satisfactory and competitive performance level has not been proceeding at the same speed. This paper presents a framework for the development of performance-based service strategies for the O&G industry. The framework considers various influencing factors and their attributes, as well as performance factors categorized as critical success factors, performance killers and cost drivers. The framework focuses on establishing and maintaining a relationship between involved parties, and as well as on achieving an agreeable service performance. The framework has been developed based on a case study in the Norwegian O&G industry. The case study maps currents practices, validates the influencing factor attributes, as well as suggesting important performance factors. The proposed framework can support practitioners in the O&G industry to develop performance-based service strategies, and can be adapted for other industries as well. Moreover, the framework can assist practitioners in reducing costs and improving performance.

Keywords: Service strategy influencing factors and their attributes, critical success factors, performance killers, cost drivers, oil and gas industry, Norwegian Continental Shelf

Introduction and background

The O&G industry operating on the Norwegian Continental Shelf (NCS) is gradually stepping into a new stage of development, as many of the O&G fields are coming closer to the end of their plateau phase and some fields are entering the tail-end phase of their production life (NPD Report, 2003; 3i Report, 2004; NPD Report, Facts 2005). At these stages it becomes essential to reduce the operational expenses (OPEX)[1], or to raise the O&G production volume to extend production period and to prolong the economic lifetime and tail-end production phase. If possible, both alternatives should be explored. The production may be increased by connecting new deposits to existing production facilities or by implementing measures for enhanced O&G recovery from existing deposits (see for example, Schulte et al., 1993). However, this is often not feasible. Reducing OPEX can delay the production cut-off, but can be challenging since the production facilities, equipment and machinery often is old, worn and deteriorated, and therefore may have increasing failure rates. Moreover, compared to modern technology, the production facilities may be ineffective and inefficient, lacking, for example, instrumentation for modern control and condition monitoring. Figure 1 depicts the potential increased profits and extension of production period based on improving operational strategies to reduce OPEX.

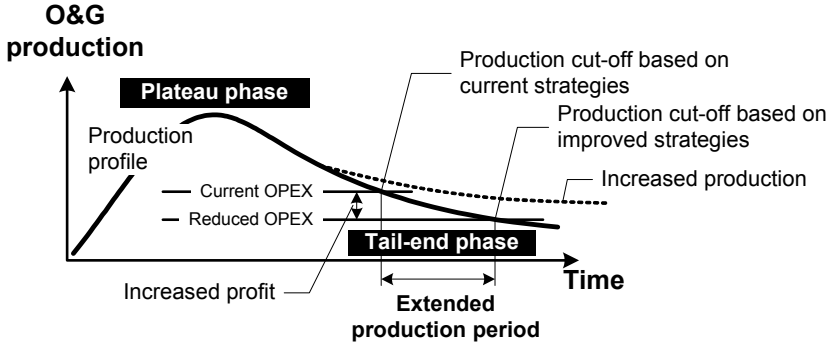

Figure 1 Extension of the production period by reducing operational and maintenance costs

Advanced and complex technology, in general, requires skilled operational and maintenance personnel. Such technology is most often not maintenance-free, and therefore usually requires spare parts, diagnostic assistance, and other product

[1] OPEX includes all costs to run the production facility (e.g. operational and maintenance costs, supply and logistics costs, manpower costs, etc).

support. Often such systems employ advanced electronics and control software that need to be upgraded and/or modernized. In addition, services are required for enhancing operational skills and improving product performance (see for example Lele and Karmarker, 1993; Mathieu, 2001a and 2001b). Such services demand intimate knowledge of a customer's operational requirements, operating environment, and geographical location, as well as other influencing factors (Kumar and Kumar, 2004a).

Traditionally, companies outsource non-core activities and activities which require special expertise and tools to specialist companies able to deliver the services better and more cost-efficiently. Companies outsource activities to ensure the production and achieve cost benefits, whilst improving performance of services and their delivery capability (Kakabadse and Kakabadse, 2002). Responsibility and control over these activities are partially transferred to the service provider. Outsourcing normally is considered to be a long-term strategic decision (see, e.g., Lysons and Gillingham, 2003; Bragg, 1998). Allen and Chandrashekar (2000) point out that "hotels outsource concierge services, airlines outsource maintenance and customer services, insurance companies outsource actuarial services, banks outsource mailrooms and manufacturers outsource customer support". In the O&G industry often companies outsource drilling operations, well completion, geophysical logging, facility construction and modification, etc. Lately, some operators are outsourcing the production facility operations and maintenance activities to specialist companies able to run the production facility at reduced OPEX. On the NCS some O&G operator companies are only owning and administering the O&G field, whilst the operation of the O&G production facility is outsourced to specialist companies.

Players involved in the O&G production process want the best possible performance (e.g. concerning profit, availability, deliverability, health, safety and environment (HSE), etc.) out of the production process at the lowest possible cost, as shown in Figure 2. To achieve this, the parties who are involved in, and/or influence the operational performance of the production facility, need to deliver the expected performance according to the defined needs, wants, and preferences. The owners and the operators need to decide performance goals, resource use, and support service requirements. On the other hand, the service providers need to decide on how they can help their customers to achieve their performance goals, and find ways to deliver the services in the most efficient way to reach their own performance goals (Anderson and Narus, 1995). The objective is to create a win-win situation for all the involved parties. This becomes even more critical in the tail-end of O&G field recovery.

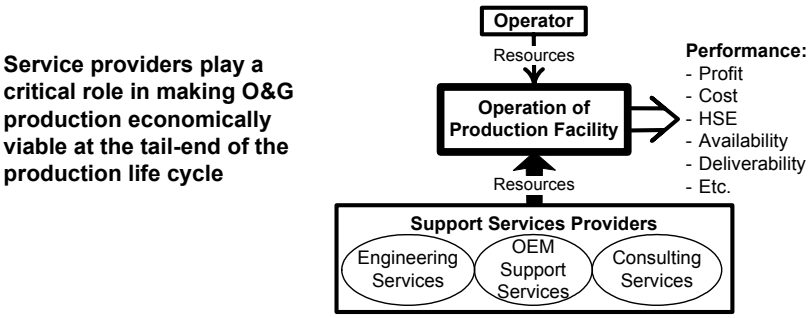

Figure 2 Service provider's role in enhancing the operational performance of an O&G production facility

Against this background we believe that there is considerable potential for improving O&G production facility operational performance through developing improved and better-formulated service strategies.

Development of a performance-based service strategy framework for the O&G industry

Services can be described as deeds, processes and performance (Zeithaml and Bitner, 2000). Deeds are activities that solve problems, which customers cannot solve independently. A service process is used to carry out the necessary deeds. Performance concerns how well the deeds are performed and encompasses service process effectiveness and efficiency. To provide excellent services, an organization needs to consider likely customer and project requirements and to make plans for delivering the service accordingly. Such an overall plan is often referred to as a service strategy (see, for example, Hope and Mühlemann, 1997; Grönroos, 2000).

A service strategy is a plan for achieving the service goals of both the service receiver (buyer) and the service provider (seller). The plan states what services are needed (i.e. the service content and outcome), where they are needed (the location), how they are to be delivered (the service delivery process), when they are to be delivered and for how long time they are needed (timing and duration), to whom to deliver them and what resources are needed (personnel, skills, tools, equipment, etc.), and why the services are needed (the reason). The plan should also suggest approaches to fulfilling the defined service requirements to achieve the service goals, and define how to measure or evaluate the service performance (for more details see also Hope and Mühlemann, 1997; Mintzberg, 1978; Manarro-Viseras et al., 2005; Chaharbaghi and Willis, 1998).

A professional organization develops a short-term or long-term strategy to plan where it wants to go. Without such a strategy it is easy to get lost and deliver

imperfect or wrong services, or deliver services ineffectively or with an unsatisfactory performance (Hope and Mühlemann, 1997). To develop a service strategy one needs to consider all the factors that will influence the service requirements (content), as well as the factors that will influence the core business activities for both the customer (buyer) and the service provider (seller) (Kumar and Kumar 2004a, see also Nicoulaud, 1988). The strategy should focus on (long-term) performance and on assisting the customer in taking maximum advantage of a technical or organizational business process. Furthermore, the strategy should consider how to execute the strategy and how the services are to be delivered to achieve customer satisfaction, retention, and loyalty (Zeithaml et al., 1990; Zeithaml and Bitner, 2000; Grönroos, 1998). Therefore, it is essential to identify the performance parameters for both the service seller and the service buyer.

In this paper a case study is conducted to validate the framework depicted in Figure 3 for the development of performance-based service strategies for the O&G industry. The framework is based on a conceptual framework for developing a service strategy for an industrial product based on a literature survey (Kumar and Kumar, 2004a). The framework illustrates the major factors that have influence on the development of the performance-based service strategies. Factors such as *geographical location, maintenance needs, operating environment,* and *operational requirements* have an influence on the specification of what services are required. As such, these factors need to be considered when defining the concrete service specification. These requirements create a foundation for defining a service strategy. In addition, the *service buyers' strategy, the service sellers' strategy,* as well as *external factors* will have influence on the implementation and execution of a service strategy. Furthermore, each influencing factor has attributes that have a concrete impact on the performance of the service strategy implementation and execution. To reduce or avoid the gap between required and actually delivered services, a prudent service provider and a customer need to agree on performance measurement parameters which take into account critical success factors, performance killers, and cost drivers. Moreover, a performance measurement system needs to be in place to improve the service delivery and the service strategy on a continuous basis. To update the service strategy, one needs to reassess the influencing factors and their attributes periodically. The framework links a service provider's service delivery strategy (SDS) with a service customer's service reception strategy (SRS). The SDS and the SRS need to be aligned to avoid gaps and conflicts (see also Markeset and Kumar, 2005).

The suggested performance-based service strategy framework should function as a foundation for delivering and receiving industrial services. Therefore the involved parties have to agree on what influencing factors, attributes, as well as performance measures, need to be considered when developing a performance-based service strategy.

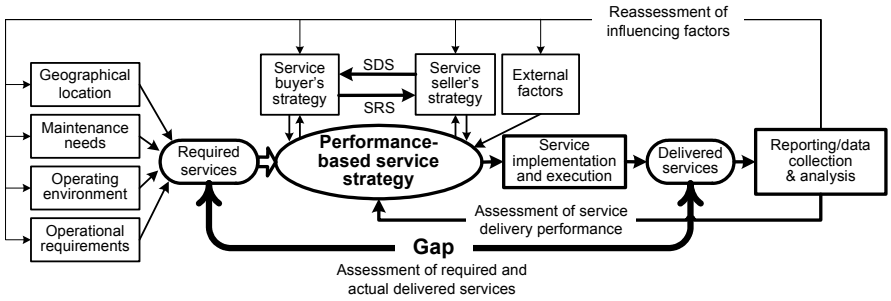

Figure 3 A framework for the development of a performance-based service strategy (SDS: service delivery strategy, SRS: service reception strategy)

To verify and validate the suggested performance-based service strategy framework for the O&G industry a case study was conducted. The case study identifies current practices in the North Sea O&G industry and service strategy influencing factors (geographical location, maintenance needs, etc.) and their attributes. Furthermore, the case study identifies performance factors that can be used to assess the service delivery process, and the gap between delivered and required services. The case study focuses on the development process of a performance-based service strategy. The actual implementation and execution of the strategy is not discussed in this paper.

Case study

The survey was conducted among O&G companies in Norway. We focused especially on external and internal services needed to support (or perform) O&G operation and maintenance activities. Examples of such services include:

- Insourcing of specialists to conduct work which is outside the competence area of the company (e.g. expertise from an original equipment manufacturer (OEM) needed to diagnose or repair an advanced piece of equipment/machine/system).
- Outsourcing of a part of the operation or clearly defined activities that are not part of the company's core focus area (e.g. maintenance and modification contracts of limited duration, design of a new module)
- Outsourcing of large-scale activities with an extended scope as part of a business strategy (e.g. operation and maintenance of an entire platform in the tail-end phase, as is done in one example in the British sector of the North Sea)
- Delivery of services related to product support (field service, spare parts, training, diagnostics services, remote support, etc.)

- Remote support requiring specialist services not normally available at the plant site

Purpose and goal

The main purpose of the case study was to collect data and information to develop and validate a performance-based service strategy for the O&G industry. The case study was divided into three sections, the first of which focused on mapping existing practices. The second section focused on validating service strategy influencing factors and their attributes. Major attributes were listed for each influencing factor. The third section focused on mapping the performance measurement methods which the companies were using and which they perceived to be important in the development and execution of a service strategy. Performance factors such as critical success factors, performance killers, and cost drivers were also mapped. The structure of the case study is depicted in Figure 4.

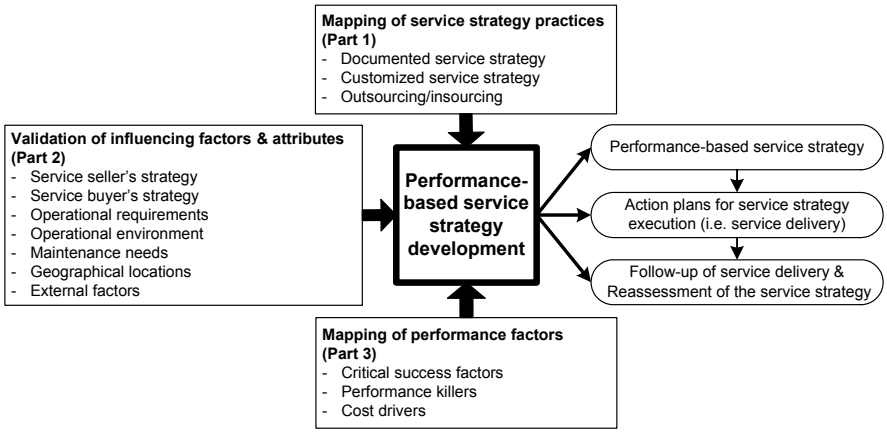

Figure 4 Overview of case study construction

Methodology

To obtain a broad picture and to validate the framework we focused the survey on selected companies active in the O&G industry on the NCS. A reference group with two participants from the O&G industry (a chief maintenance engineer and a research and development manager) and three senior researchers from the Operation and Maintenance area was established to assure quality and to guide the research project. The industrial members had 15 and 30 years experience respectively, and the senior researchers all have PhD and 8, 16 and 25 years of experience within engineering, operations, maintenance, and industrial services. Initially, a pilot study was conducted

among the reference group members and some relevant personnel from the targeted companies to improve the quality of the questionnaire. Participants were chosen based on their knowledge, competence and experiences in the O&G industry. They were requested to give their feedback concerning ambiguity, comprehensiveness and relevance. Their comments were related to the formulation of questions and attributes, the scale of the study, as well as selection of participants. They also suggested some additional attributes and questions. The comments and suggestions were considered and implemented.

The same questionnaire was used for all participants in the study. The participants were chosen from top management, middle management and operative level from different companies active in the O&G industry on the NCS. Participants were selected based on their understanding of this area, knowledge of sellers'/buyers' businesses, experience within industrial services and contracts from either customer or provider side. In average they had approximately 23 years of work experience.

The questionnaire was divided into three parts. In Part I we mapped the existing service strategy and used Yes/No questions. In Part II the focus was on validating the influencing factor attributes and rating them based on their degree of influence on a service strategy. In Part III the focus was on mapping performance factors such as critical success factors, cost drivers, performance killers, as well as on performance measurement systems used in companies. A critical success factor is a factor/issue that is decisive for the success of an activity (e.g. competence and skills, marketing, input resource quality, sales and distribution channel, planning, focus on the customer's needs, etc.) (see also Johnson and Scholes, 1999). A performance killer is a factor/issue that influences processes in a negative way, even though it is not visible or strong (e.g. a process/activity bottleneck, poor tools, not well-negotiated contract, etc.). A cost driver is a major cost that dominates the total costs of the activity (e.g. high energy requirements, expensive distribution or intermediary, poor storage, high personnel cost, etc.). See also Markeset and Kumar, 2005 for discussion of cost drivers and performance killers.

The information was collected using face-to-face interviews and e-mail. Those participants who did not have time available within the timeframe were given an option to answer using e-mail. In this case their answers were discussed over the telephone after a review to clarify their answers. The questionnaire was sent to 29 persons in 24 different companies using e-mail. Twelve persons from 12 companies responded using e-mail within the timeframe stipulated.

Eighteen persons from 12 different companies were invited for in-depth face-to-face guided interviews and 14 persons from 12 companies accepted. The interview time varied between one and two hours. Each participant was asked to answer Part I and Part II before the interview. Part III, consisting of open-end questions, was the

main focus for the face-to-face interview. However, we also discussed their answers in Part I and II in the interview. A report was prepared for each individual response and sent to the participants for review and verification. Thereafter, the information was analyzed. In total, we collected usable data and information from 26 participants out of 47 invited.

Mapping of current practices – Part I

Documented service strategy: The analysis shows that most of the companies (25 out of 26) have some form of "service strategy document" (typically named 'frame contract', 'frame strategy', 'standard contract', etc.) with a content and philosophy similar to a service strategy. Part of the "service strategy document" is standardized, whilst other parts are defined according to the needs and requirements of each individual project or specified case.

Customized service strategy: The survey shows that most of the companies (21 out of 26) have a customized "service strategy document" in the form of different types of contracts. The customization process is influenced by the quantity of work (the size of the service contract), the geographical locations, the local rules and regulations, the projects' needs and requirements, the market situation, the cost and the capability needed, etc.

Sourcing of services: The survey shows that most of the companies (21 out of 26 participants) *outsource* services related to non-core activities. The companies choose to outsource these activities because they would not be profitable in the long run, even though the companies would be capable of developing all kinds of required skills and competence. One participant stated, "*One of the operators developed all kinds of competence in-house when their O&G field was in the plateau phase. However, when the field reached the tail-end phase, the salary costs became a burden and the company had big losses*". Only five out of 26 (mostly consulting companies) said that they did not outsource activities. They develop competence in-house if needed. They indicated it could be interpreted as a weakness in the market if they were to choose to outsource parts (or the whole) of their services. The participants stated that they outsource services like drilling and well services, information technology services, inspection, maintenance and modification services, engineering study and analysis services, certification services, etc.

Seventeen out of 26 participants said that in some cases specialists and/or tools in these services were *insourced* and integrated with their own employees for a shorter or longer time based on needs and workload. One also retains responsibility and control of the activities within the company. In some companies *co-sourcing* is employed where a company and a service provider is cooperating solving a problem

and sharing risks. In this case a company keeps the control over the activities but uses external expertise to enhance performance and to reduce costs. Responsibility and control is in this case shared between the parties (see also ABB Review, 2004). Several companies indicated that co-sourcing arrangements will be further explored.

Validation of service strategy influencing factors and attributes – Part II

In part 2 of the questionnaire the participants assessed 49 attributes based on their degree of influence on a service strategy. They were asked to use a scale, **very high influence (5), high influence (4), medium influence (3), low influence (2),** to **no influence (1)**. The results are summarized in Table 1. The influencing factor attributes are sorted according to *percentage significant influence level* (*SI*) and average score. *SI* is calculated using the percentage of responses giving the attribute a score of 3, 4, and 5 (medium to very high influence). In addition the percentage of responses giving the attribute a score of 1 (No influence, *NI*) is listed. The statistical average ($\bar{x}$, equation 1) and standard deviation (s, equation 2) is given, where x_i is the sample response (i: 1, 2, 3…n), and n is the number of responses.

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad (1)$$

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2} \qquad (2)$$

The results show that most of the attributes have a significant impact on a service strategy. The 40 first attributes are considered to have *medium to very high influence significance* (*SI*) by 80% of the participants. Only three attributes (attribute 35, 38 and 40) among the 40 first attributes are considered to have *no influence* (*NI*) by 10%, 10% and 15% respectively. Most of these attributes (32 out of 40) are considered to have *no influence* by less than 5% of the participants. Attributes 41-49 are considered to have medium to very high influence by 39% to 80% of the participants. Seven of nine of these attributes (attributes 43-49) are considered to have *no influence* by 10% to 24% of the participants. It is observed that HSE (attributes 16, 6 and 25) are rated high based on averages. The reason could be that HSE regulations are heavily enforced on the NCS.

Considering the statistical analysis it is observed that the distribution of the attributes shows no clear multi-modality and therefore the average ($\bar{x}$) is a good measure of degree of influence. Furthermore, the statistical analysis of averages and standard deviation (s) supports the ranking of the attributes based on influence

significance (*SI*), as well as the conclusion that there is a high degree of agreement about attribute influence level among the survey participants.

Table 1 Validation of influencing factors' attributes

No: Attribute number; **IF**: Influencing factors (OR: *Operational Requirements*, SBS: *Service Buyer's Strategy*, SSS: *Service Seller's Strategy*, MN: *Maintenance Needs*, GL: *Geographical Location*, OE: *Operational Environment*, EF: *External Factors*, see Figure 3); **n**: Number of responses; ***SI***: Significant Influence = Percentage of ratings from *medium to very high influence* (Ratings 3+4+5); ***NI***: No Influence =Percentage of ratings of *no influence* (Score 1); $\bar{x}$: Average; ***s***: Standard deviation

No	IF	Influence attribute	*n*	*SI*	*NI*	$\bar{x}$	*s*
1	OR	Service buyer's requirements (e.g. System performance/availability requirements, production schedules)	22	100 %	0 %	4.41	0.59
2	SBS	Goal and objectives of the company (e.g. O&M objectives and strategy)	22	100 %	0 %	4.36	0.73
3	MN	Existing and future operation and maintenance practices	20	100 %	0 %	4.20	0.83
4	SBS	Reputation of service seller	20	100 %	0 %	4.20	0.70
5	OR	Expected service life of platform or system (e.g. Are there requirements with respect to modification and/or upgrading of platform/system during lifetime?)	22	100 %	0 %	3.82	0.73
6	OR	Safety (Safety of the workers and surrounding population. e.g. accidents)	25	96 %	4 %	4.76	0.88
7	SSS	Tools and methodology (e.g. What tools and methodology does the organization use to provide the services?)	24	96 %	4 %	4.13	0.99
8	SSS	Customer's manpower standard requirements (Skills and qualifications)	24	96 %	4 %	4.04	1.04
9	SSS	*Customer's quality requirements* - What are the requirements of service product quality?	24	96 %	4 %	3.92	0.97
10	SSS	*Customer's quality requirements* - How does the customer measure the quality of services (by auditing or using other methods for measuring service performance?	23	96 %	4 %	3.70	1.02
11	MN	Observed conditions of the asset	22	95 %	5 %	4.05	0.95
12	SBS	Cost	21	95 %	5 %	4.38	1.02
13	SBS	*Maintenance strategy* - Corrective maintenance (see CEN Standard prEN13306)	21	95 %	5 %	4.19	1.03
14	SBS	*Maintenance strategy* - Predictive maintenance (see CEN Standard prEN13306)	21	95 %	5 %	3.95	1.07
15	SBS	Operational strategy	20	95 %	5 %	4.20	1.01
16	OR	Health (Issues which can impact long-term health of the employees and surrounding population, e.g. pollution, ergonomics, noise)	25	92 %	4 %	4.60	1.04
17	SSS	Competence, skills, ability & capability	25	92 %	4 %	4.48	1.05
18	MN	*Technical characteristics of system* - Reliability (see CEN Standard prEN13306)	25	92 %	4 %	4.24	1.01
19	GL	Manpower (e.g. Available workforce with right qualifications, skills and capability)	24	92 %	8 %	3.88	1.12

No	IF	Influence attribute	*n*	*SI*	*NI*	$\bar{x}$	*s*
20	SBS	Flexibility of service seller	24	92 %	4 %	3.75	0.94
21	MN	*Technical characteristics of system* – Capacity	22	91 %	5 %	3.55	0.91
22	SBS	*Maintenance strategy* - Preventive maintenance (see CEN Standard prEN13306)	21	90 %	5 %	4.05	1.16
23	SBS	*Maintenance strategy* - Campaign-based maintenance	21	90 %	5 %	3.90	1.09
24	EF	Resources cost variation (e.g. Material cost, energy cost, labor cost)	21	90 %	5 %	3.33	0.97
25	OR	Environment (e.g. Pollution from product or production process, pollution from product at end of life)	25	88 %	4 %	4.44	1.12
26	MN	Fluctuation in O&G production rate (profile)	16	88 %	6 %	3.63	1.09
27	GL	Supply chain (e.g. logistics, local suppliers, service contracts)	24	88 %	8 %	3.50	1.10
28	EF	Union requirements (e.g. Salary, overtime payments, bonuses)	23	87 %	9 %	3.39	1.08
29	MN	*Technical characteristics of system* - Functionality	22	86 %	5 %	3.68	0.99
30	MN	*Technical characteristics of system* - Maintainability (see CEN Standard prEN13306)	22	86 %	5 %	3.59	1.05
31	SBS	*Maintenance strategy* - Immediate maintenance (see CEN Standard prEN13306)	21	86 %	5 %	3.95	1.20
32	MN	*Technical characteristics of system* - Quality	21	86 %	5 %	3.71	1.10
33	MN	Age of the asset	21	86 %	0 %	3.43	0.98
34	SBS	Service reception strategy (e.g. Outsource jobs/projects, insource specialist personnel)	20	85 %	0 %	3.75	1.07
35	SBS	*Maintenance strategy* - Opportunity-based maintenance (British Standard 3811:1993)	20	85 %	10 %	3.70	1.30
36	OE	Corrosiveness	24	83 %	4 %	3.54	1.10
37	GL	Government legislation (e.g. Local taxes, insurance, terms and conditions for obtaining license, work permit)	23	83 %	9 %	3.74	1.29
38	EF	Product price fluctuation (e.g. Oil and gas price)	21	81 %	10 %	3.57	1.25
39	GL	Infrastructure (e.g. transportation, power distribution, communication)	25	80 %	8 %	3.36	1.11
40	SBS	*Maintenance strategy* - Temporary maintenance (i.e. Temporary solution of problems in non-critical systems, e.g. patching of pipes, welding)	20	80 %	15 %	3.20	1.24
41	GL	Cultural aspects (e.g. If you work in a foreign country, one need to know the local language or have common language for communication. Similarly, one needs to have knowledge about local business traditions, rules and regulations)	22	77 %	5 %	3.41	1.14
42	OR	Residual service life of assets (What is the residual design life of the asset and system, and what is the needed service life, etc.)	23	74 %	4 %	3.22	1.04
43	OE	Humidity/moisture	22	68 %	14 %	3.05	1.25
44	OE	Temperature	21	67 %	10 %	3.19	1.29
45	EF	Unforeseeable events ("Acts of God": e.g. storm, earthquake, flood)	21	67 %	19 %	2.95	1.36
46	EF	Strikes	21	67 %	19 %	2.86	1.24
47	OE	Dust	21	57 %	24 %	2.81	1.40
48	EF	Uncontrolled forces which may affect the service process (e.g. Terrorism, mafia and other criminal activities).	19	47 %	21 %	2.58	1.30
49	OE	Wind	18	39 %	17 %	2.39	0.98

Mapping of performance factors – Part III

In Part III of the questionnaire the participants were asked to mention performance factors such as critical success factors, performance killers and cost drivers, which they regarded as important in a performance-based service strategy for the O&G industry on the NCS. Important critical success factors mentioned were related to *service strategy* (e.g. focus on customers' needs, planning processes, clear goals and scope of work), *workforce and organization* (e.g. competence and skills, personnel motivation and attitude, mode of communication, teamwork, activity coordination), *regulatory requirements* (e.g. number of fatal accidents (safety), number of unwanted hazardous events (health), nitrogen oxide (NO_x) emission, leakage of hydrocarbons (environment)), and *technical system* (e.g. downtime-caused revenue losses, production facility performance).

Important performance killers mentioned were related to *service strategy* (e.g. excessively long delivery time, negligence and/or lack of control of known errors, poor planning, unaligned relationships, too much documentation and details), *workforce and organization* (e.g. insufficient competence and experience, unacceptable attitude and motivation), and *technical system* (e.g. unreliable equipment, insufficient equipment capacity, poor tools, immature design basis).

Important cost drivers mentioned were related *workforce and organization* (e.g. man-hour costs, un-trained personnel, travel cost), *technical system* (e.g. operation and maintenance cost, logistics, inventory and spare parts costs, and material cost), *regulatory requirements* (e.g. certification costs, insurance costs, CO_2 release tax).

Some these performance factors can be classified as critical success factors, cost drivers, or performance killers dependent on situation, magnitude, activity importance, etc. For example, we observe that competence and skills can be a critical success factor, performance killer, or a cost driver. However, it is a critical success factor if an activity could fail because a certain competence and/or skill is lacking. It can be a performance killer if the activity performance is suffering because some of the personnel have insufficient competence and skill to perform an activity well compared to expectations. Moreover, if an activity requires specialized types of competence and skills, this could cause that the salary costs amount to a substantial part of the total costs and become a cost driver for the activity. One participant stated that *critical success factors, performance killer and cost drivers will vary for various life cycle phases*. For further discussion of performance factors in the O&G on the NCS, see Liyanage, 2003, and Ellingsen et al., 2002.

The analysis of the survey shows that most of the participants use various methods to assess service performance and collect data and information from customers, suppliers and their own employees. Some of the methods used include: regular

meetings to discuss the progress of and obstacles to the service delivery process, continuous monitoring of the process performance, the use of feedback forms to collect data the mapping of market trends, visits to customer sites, project reports and expenditure assessments. Only a few of the companies stated that they had installed systematic and well-defined performance measurement systems. However, most of the participants stated that they use a number of key performance indicators in their business operations. One participant stated that *any service strategy must be analyzed and assessed regularly in order to determine how the strategy complies with the company's overall HSE, plant regularity, cost and profitability requirements.*

Discussion and conclusions

The survey reveals that the service relationships between companies are regulated and customized in the form of contracts based on involved parties' needs, wants and preferences. However, they do not use a systematic framework for developing a service strategy to be implemented in the contracts. Most of the contracts are developed based on traditional approaches, and the service content based on basic needs. Furthermore, service performance is becoming increasingly a core focus for involved parties and thus important to compete in the market. In the survey, some of the participants stated that they focused their service strategies on the delivery of total integrated packages including the physical product and supplementary services (or "total service offerings"). This is a trend that is developing in other sectors as well (see e.g. Vandermerwe and Rada, 1988; Stremersch et al., 2001; Bovik, 2004; Kumar and Kumar, 2004b; Nordin, 2005). Therefore, there is a need for a framework for development of performance-based service strategies.

As discussed above, the attributes need to be assessed and customized based on the individual needs, wants, and preferences of the involved parties, the technical installation (production facility), etc. To avoid conflicts and hindrances, knowledge and competences from of a variety of disciplines are usually required to evaluate the importance of the various influencing factors. Moreover, the service strategy and influencing factor attributes should be reassessed at regular intervals in the implementation and execution phase and adjusted according to changing needs. In the case study it was observed that most of the suggested influencing factor attributes are considered to be important and therefore need to be considered when developing a performance-based service strategy for the O&G industry in the North Sea. Figure 5 depicts the attributes grouped for each influencing factor and listed in accordance to significant influence (SI).

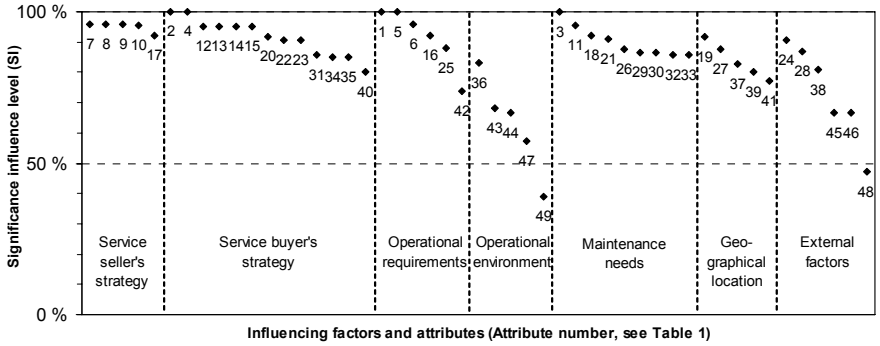

Figure 5: Attributes according to influencing factor and influence significance level (*SI*)

The results from the analysis show that some of the performance factors (success factors, cost drivers and performance killers) are similar or identical to attributes in functionality. This reinforces the observations in the survey and indicates that the development of performance factors should be based on an analysis of influencing factor attributes. The performance factors need to be integrated in the initial phase of the development process. However, when some experience is gained from executing the service strategy, one must make sure to update the existing strategy and the performance measurement systems in accordance with changes in customers' needs, wants, and preferences.

The Norwegian O&G industry is, in general, excellent at both developing and using new technology, services and organizational management. However, companies need to become more critical when buying services and when improving the service delivery process with respect to cost-effectiveness and other performance measures. The implementation of performance-based service strategies will create a win-win situation for all parties and lead to a better return on investments, improved service quality and enhanced customer satisfaction, as well as customer retention and loyalty.

Managerial implications

As industrial services become increasingly important for production facility performance in an increasingly globalized and competitive world, companies need to become precise in selecting the right services and the right service providers. Therefore, effective and efficient service strategies, seen from an operational performance perspective, need to be developed.

The proposed framework provides a foundation for managers to develop a performance-based service strategy. The framework takes into account strategy influencing factors, their attributes and performance factors. Furthermore, it takes into account reduction of potential gaps between required services and delivered services as well as continuous monitoring of the strategy execution performance.

Periodical reassessments of influencing factors and their attributes are included in the framework to update and improve the service strategy, based on revised information, knowledge and requirements. Managers can use the framework and suggested attributes to analyze their needs and enable the development of a performance-based service strategy to become more efficient and cost-effective. Furthermore, the framework provides a foundation for managers to negotiate a performance-based service strategy. The framework is developed based on a case study in the O&G industry on the NCS, but can easily be adapted to other industries as well.

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Paper V

Kumar, R., Markeset, T. and Kumar, U. (2005), "Implementation and execution of industrial service strategy: a case study from the oil and gas industry"

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Implementation and execution of industrial service strategy: a case study from the oil and gas industry

Rajesh Kumar[1], Tore Markeset[1] and Uday Kumar[2]
[1]University of Stavanger, Stavanger, Norway
[2]Luleå University of Technology, Luleå, Sweden

Abstract

Industrial services are becoming increasingly important for achieving business and production goals and for improving competitiveness. However, a well-defined service strategy is missing in many companies, even though elements are included in other functional strategies. In this paper a framework is used as a basis for considering factors and issues that affect service strategy implementation and execution processes.

Research demonstrates that the service implementation and execution process is equally important and critical as the service strategy development process. Based on a comparison of two types of contracts from the oil and gas industry, differences in service strategy implementation and execution are reviewed in the context of a developed service strategy framework. The main focus is on the execution of service strategies. Performance factors (i.e. cost drivers, performance killers and critical success factors) of the service strategy implementation and execution process, as well as issues, challenges and opportunities arising in various stages of the implementation and execution process, are discussed in relation to the oil and gas industry in the North Sea.

Keywords: Industrial services, service delivery strategy, service implementation and execution process, performance factors

Practical implications

In this paper, implementation and execution process of industrial service delivery strategy for oil and gas industry in the North Sea is discussed. The study is based on a literature survey, comparison of contracts and information collected through face-to-face interviews and therefore the content of the paper will be useful for business managers dealing with maintenance contracts.

Introduction and background

In Norway the oil and gas (O&G) industry is entering a new era of development as the production in some of the fields has entered or is entering the tail-end phase. In this phase unit operational costs increase due to declining production and stagnant or increasing operational and maintenance (O&M) costs (NPD Report, 2003). To prolong the economic lifetime of the field it is essential to reduce the operational expenses (OPEX), and/or to raise the production volume. This may be feasible if the involved parties manage to get control of the OPEX, and cooperate to optimize performance.

Kumar et al. (2004), underline that "*…the role of supporting services needed to exploit product's function to an agreeable performance is becoming increasingly important*". Industrial service contracts need to be negotiated carefully to avoid disagreement and inadequate performance. Companies are becoming progressively more dependent on service providers to deliver performance at a competitive level according to stakeholders and market demands. However, to be able to achieve this the service delivery process need to be carefully defined, negotiated, and agreed upon considering involved parties' needs, wants and preferences. Moreover, a service strategy need to be defined on how to implement and thereafter execute the agreed upon service strategy. One needs to assure that there is no force that can influence the process in such a way that it threatens to become critical and/or a stopper (Grundy, 1998).

This demands a different business approach for both operator and service companies. Effective and efficient service strategies are needed where major influence and performance factors are considered, as well as customers' demands and requirements and providers' expertise and competence (Kumar and Markeset, 2005). In other words, a prudent organization needs to formulate a service strategy that is "*appropriate for the organization, appropriate for the industry, and appropriate for the situation*" (Alexander, 1991). He further emphasizes that effective strategy implementation and execution relies on maintaining a balance between preventing failures and promoting success simultaneously. When there is a proper alignment between strategy, administrative mechanisms and organizational capabilities, it will

be easier to implement and execute the strategy and to achieve the desired objectives (Okumus, 2003).

However, a well-developed service strategy does not automatically mean well implemented (see also Al-Gamdi, 1998). Strategic management gradually is shifting from paying 90% attention to strategy formulation and 10% to strategy implementation, to paying equal attention to both (Grundy, 1998). Traditionally, it is believed that strategy implementation and execution is less glamorous than strategy formulation, and that anyone can implement and execute a well-formulated service strategy. Therefore, implementation and execution has attracted much less attention than strategy formulation or strategic planning (Alexander, 1991; Bigler, 2001). Organizations face difficulties while implementing and executing their strategies for different reasons. There is uncertainty about what these processes include and where they begin and end. Such uncertainty includes weak management roles in implementation, a lack of knowledge and communication to guide their actions, unawareness or misunderstanding of the strategy, poor coordination, inadequate capabilities, competing activities within the working team, unfortunate marketing timing, uncontrollable environmental factors, misaligned operation and insufficient monitoring and evaluation of the process (Alexander, 1985; Gilmore, 1997; Okumus, 2003).

Considering the above discussed scenarios a performance-based service strategy framework was developed as shown in Figure 1. See Kumar and Markeset, 2005 for details. In the framework, factors and their attributes are ranked based on their level of influence on a service strategy. A list of critical success factors, performance killers and cost drivers of service strategy and named as performance factors has been presented as well. The framework has been validated for the O&G industry, but can be used for other industry as well.

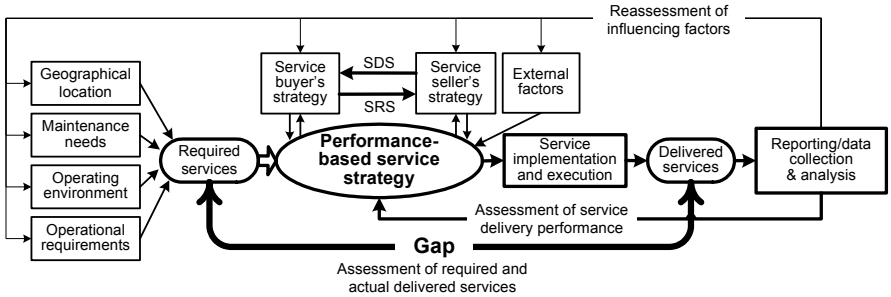

Figure 1 A modified framework for the development of a performance-based service strategy (SDS: service delivery strategy, SRS: service reception strategy)

In the service strategy implementation process, resources are allocated and an organization is designed and built to make it possible to carry out the strategic plan (see also Mintzberg, 1978). Alexander, 1991 points out that "*strategy implementation addresses the issue of how to put a formulated strategy into effect – with defined time constraint, within budget, and human resources, and its capabilities*". In the service strategy execution process, the organization utilizes the resources to deliver the services, and to carry out the strategic plan on a continuous basis throughout the predetermined life cycle. "*Without an executable plan – and the resources needed to implement that plan – even the most innovative strategy is merely words on paper*" (Wery and Waco, 2004). For more details on the strategy formulation and strategy implementation see, for example, Porter, 1980; Hope and Mühlemann, 1997; Aaltonen and Ikävalko, 2002. Service strategy implementation and execution is a complex, crucial and challenging part of the service delivery process. Figure 2 presents different approaches of strategies and service strategy process phases.

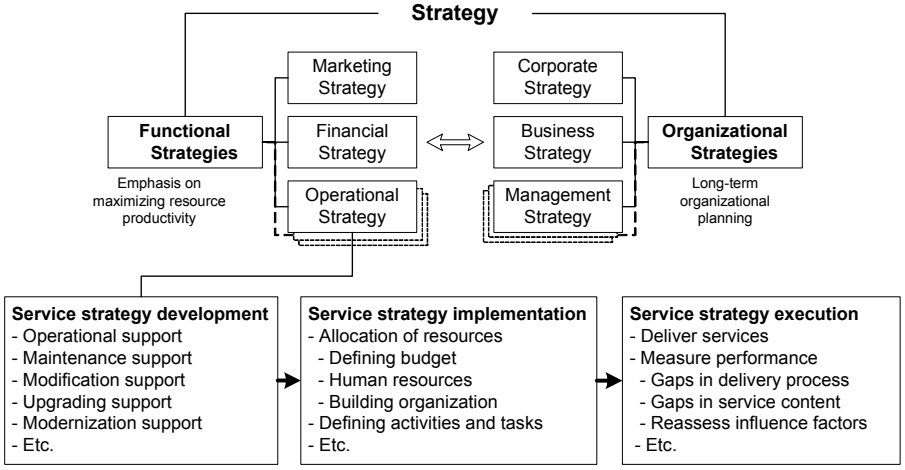

Figure 2 Different approaches to strategy

In this paper we will discuss the implementation and execution process of a performance based service strategy. We emphasize that strategy implementation and execution are different in the respect that implementation has to do with making resources available and setting up detail plans for strategy execution, whereas the execution phase the plans are enacted and the resources used. However, in the case study the main emphasis is on the execution phase. We will present obstacles and factors that can have a significant role and influence on service strategy execution. Furthermore, we will present performance factors (e.g. cost drivers, performance killers and critical success factors) that need to be considered in following-up a service strategy execution process. Our goal is to describe the complex issues that need to be considered in a service strategy implementation and execution process.

Case study

To obtain a broad picture and to map the implementation and execution process of a developed service strategy, a case study was conducted where we studied the contract for two oil and gas production facilities in the North Sea. We focused the study on the implementation and execution process of a service strategy. Furthermore, we mapped two different types of ongoing contracts contents, i.e. a production facility Maintenance and Modifications (M&M) contract and a production facility Performance based operational (PBO) contract.

The main purpose of the case study is to map the implementation, execution and follow-up process of two different service contracts and thereby validate the performance-based service strategy framework as shown in Figure 1.

To get an overview of the complexity of a service contract we first compared the content of an M&M contract and a PBO contract. The M&M contract concerns the maintenance and modification of a production facility located on the Norwegian Continental Shelf (NCS), whilst the PBO contract concern the operation of a production facility located on the United Kingdom Continental Shelf (UKCS). Secondly, we conducted guided interviews with management and operative personnel from different companies who were involved in the implementation and execution process of these contracts.

The interviews were summarized and verified. Some interviews were tape-recorded. We used the same questionnaire for all participants of the case study. A reference group with two participants from industry and three senior researchers was established to assure quality and to guide the research project. Initially, a draft copy of the questionnaire was sent to the reference group members and some relevant personnel from the targeted companies as a pre-test to improve the quality and to validate the questionnaire. They were requested to give their feedback concerning ambiguity, non-relevance of the survey for the study etc. Their comments and suggestions were considered and implemented.

The research data and information were gathered from four companies (i.e. the production facility owner, production facility operators, and service providers). We interviewed 13 employees from top management, middle management and operative personnel. Conclusions and suggestions are drawn based on collected information from documents, experience, and interviews.

To get an overview of service strategy formulated goals and intentions we analyzed the contracts with respect to focus, differences and contents. Thereafter, we analyzed the interviewed participants' responses.

Analysis part 1: Contract comparison

The M&M contract: In the M&M contract all terms and conditions (e.g. time period, amount of work, cost, hours, etc.) were defined. The payment was based on hours within a specified timeframe and budget. In the M&M contract there were conventional and straightforward contractor–client relationships. The client defined the requirements with respect to work scope and volume. Thereafter, the contractor fulfilled the defined requirements at agreed time and cost. The M&M contract content can be summarized as:

- Scope of work
- Method for payment (hourly-based)
- Time-cost-resources focus
- Performance goals and incentives
- Requirements with respect to HSEQ (health, safety, environment and quality)
- Subcontractors roles and issues
- Liability issues

The contractor provides the M&M support services specified in the contract, whilst the customer (client/operator) has the responsibility for the operation of the production facility. The production facility operator arranges beds, transportation, access to the work site, and all main safety functions for personnel, plant and environment, for the service process.

The PBO contract: In the PBO contract all terms and conditions were defined as well. However, since the contract implementers and executors receive payment based on performance, both parties seem to be more flexible than in the M&M contract. In the early stage of the contract they develop an execution model, but the model had been changed several times during the contract period. The changes are based on the client's needs and preferences, as well as the performance of the service provider.

In the PBO contract the contractor and client collaborated and shared risks, but not profits. Roles, responsibilities and liabilities during the project life were clearly defined in the contract. The content of the PBO contract can be summarized as follows:

- Scope of work
- Method for payment (performance-based incentive compensation model with a bonus scheme based on cost reduction and HSEQ goals)
- Responsibilities with respect to safety (the safety case)
- Cost structure based on key performance indicators (KPI)
  - Cost driving: HSEQ, production level
  - Cost reduction: OPEX (operational expenses) targets
  - Profit basis

  - Administrative costs
- Team based integrated management
- Liability issues

Analysis part 2: Analysis of guided interviews

The guided interviews focused the contract implementation and execution. The questionnaire was divided in three major focus areas:

1. Mapping of industrial service process
2. Contract execution model
3. Service strategy performance measurements

Mapping of industrial service process

Analysis of the responses revealed that both contracts are similar to some extent. Almost the same types of services are required to operate, maintain, and modify a production facility. Common *contract reasons* were reported, such as sharing risks, requirement with respect to buying the required services at competitive rates, HSEQ, etc. However, the implementers and executors of the PBO contract were more focused on reduction of operational expenses (OPEX) and maintaining HSE standards. The implementers and executors of the M&M contract stated that:

- The focus was on their core business activities
- Cost benefit analysis is the basis for the contract
- It was not worthwhile to have all kinds of service expertise in-house. Some services can be bought in the market at competitive rates with the required level of competence

The implementers and executors of the PBO contract stated that they work very interactively and closely with their customer. The PBO service provider was responsible for the operation of the production facility, but both the client and the service provider were involved in the process of running the production facility. Therefore, an interactive relationship was required. A whole year was spent integrating personnel and organization of the two parties to assure that everybody was working towards the same goals.

Contract execution model

To ensure the achievement of requirements and goals of the customer, service provider (contractor) and authority, the service provider normally develops a contract execution model. This is often referred to in the industry as a project execution model (PEM). The PEM is developed in the early stage of the project, and thereafter followed throughout the contract period. Figure 3 illustrates a typical PEM for an M&M type of Contract as used by some of the companies on NCS.

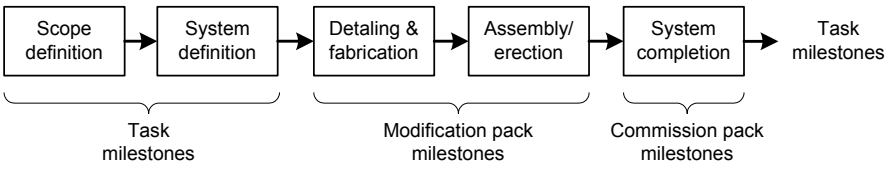

Figure 3 Overall concept of M&M type PEM

The M&M type PEM normally covers multidiscipline engineering projects where progress and quality is very much dependent on excellent internal and external activity coordination. The main objectives of the PEMs are to control management, assure and maintain HSEQ, streamline the execution process, and create clear and transparent interfaces between the involved parties.

Furthermore, the PEM describes which, when, and how activities are to be performed, and functions as a basis for interface between involved parties. The PEM defines work orders, roles, interfaces, responsibilities, and the time-period. Furthermore, checklists, tools, standards and procedures are referred to, and milestones, processes, influencing factors, acceptable quality level, etc. are defined as well. Some key deliverables of a PEM include, for example, a pre-study report, task schedule, supplier documents and drawings (SDD), system processes piping and instrument diagram (P&IDs), engineering registers, 3D models/layout, installation method, etc). Normally, a PEM is defined for:

- new large production platforms' construction projects
- larger modifications projects
- M&M projects
- PBO projects
- installation removal projects

The PBO contract implementers and executers stated that the original project execution model was very different from the updated model currently in use, and that it is an evolving and developing process. The PEM had been changed and adjusted, based on the project development and progress, as well as on changing needs. On the other hand, M&M contract implementers and executors stated that the PEM was more or less defined and fixed throughout the project life cycle.

Implementers and executors of both types of contracts gave examples of factors influencing a contract implementation and execution process. Some of them were related to:

- People and relationships
  - Relationship with and between management and personnel
  - Culture of company

  - Communication
  - Trust and dialogue
  - Openness and commitment
  - Level of turnover of personnel
  - Age combination of personnel
- Management and performance
  - Management philosophy
  - Mutual understanding between involved parties
  - Alignment of objectives
  - Focus on performance
  - HSEQ (health, safety, environment and quality) mindset
  - Delivery as promised
- External factors
  - Oil price
  - Government regulations and policies

Service strategy performance measurements

With respect to how they follow up a contract, participant expressed different practices have been employed. Both contracts have identical goals related to maximizing the production value as well as creating value for the business. The PBO contract implementers and executors used a number of performance indicators, but emphasized the importance of face-to-face meetings where problems were discussed and attempted resolved. When problems arose they attempted to discuss and agree on taking actions in favor of making the production performance better, even if it is not written or mentioned in the contract. This was in strong contrast to the M&M contract where the PEM was developed, followed, and performance was measured according to the negotiated specifications.

However, both contracts had a number of key performance indicators related to different areas and specializations. Examples include HSEQ indicators, production and production support indicators, OPEX indicators, operational performance (client judgment on performance, and scoring mechanism) financial, activity progress, time/quality, competence, innovation, actual work versus planned work, customer satisfaction index, etc. On a corporate level, there were registered as many as 167 different types of KPIs with different purposes. However, not all were paid the same attention. KPIs need to be decided considering the customer's needs, wants and preferences as well as the project's requirements.

The analysis revealed that various methods were used to collect data and information from customers, suppliers, and their own employees, to assess contract performance. Some of the methods used include: regular meetings to discuss the

progress and obstacles of the implementation and execution process, judgment against budget and KPIs, quarterly performance reports, and expenditure assessments. Some of the participants stated that they use systematic and well-defined performance measurement systems. Systems used include First Point Assessment Limited (FPAL: used to compare sub-suppliers' prices and their performance level), European Federation of Quality Management (EFQM: Quality assurance). The M&M contract implementer and executors used a computer system called "Synergy" for registering and handling the statistics of "RUE" (reports of unwanted events/ accident, etc).

Table 1 depicts some of the performance factors used in the contract implementation and execution process.

Table 1 Example of performance factors employed in contract implementation and execution phase

Performance factors	M&M Contract	PBO Contract
Critical success factors[1]	• HSEQ (Zero accidents, spills, health problems, quality caused losses) • Trained personnel and right tools • Meet agreed milestones • Focus on customers' needs and requirements	• Trust • Relationship between involved parties and personnel • Communication • Safe operation • Installation uptime • Achievement of OPEX goals • Achievement of KPIs • Managing 3rd parties' suppliers, managing own personnel (encourage and motivate personnel to do their best)
Performance killers[2]	• Inefficient support system • Demands of unnecessary documentation • ·Excessive waiting time due to delays • Poor management • Too complicated documentation and descriptions • Inflexible and inadequate terms and conditions of the contract • inadequate availability of systems (e.g. less capacity of vessel)	• Not understanding needs & requirements, and how to deliver them • Not having spare capacity of personnel (for example, if some body get sick or wants to leave replacement should always be available). Since the asset is in their end of service life (tail-end phase) it can be very tough to attract experienced people to fill vacant positions) • Losing control of 3rd parties' cost • No KPIs for 3rd parties

[1] Critical success factor: A critical success factor is a factor/issue that is decisive for the success of an activity (e.g. competence and skills, marketing, input resource quality, sales and distribution channel, planning, focus on the customer's needs, etc.) Kumar and Markeset, 2005

[2] Performance killer: a part of an activity that influences processes in a negative way, even though the part is not visible or strong (e.g. a process/activity bottleneck, poor competence and skill, poor quality input material, poor tools, not well-negotiated contract, etc.), Kumar and Markeset, 2005

Performance factors	M&M Contract	PBO Contract
Cost drivers[3]	• Administration cost • Frequent changes and new recruitment of personnel • Indirect work and unnecessary waiting time • Commercial taxes • Currency exchange rate • Wrong identification of spare parts • Rework due to wrong assumption • The use of two database systems for recording data and information (first the data and information is recorded in an internal database and thereafter transferred to the client's database. This requires extra man-hours and resources)	• Maintenance of expensive and critical systems • 3rd parties' costs are responsible for a large part of OPEX (third party: sub-suppliers and service providers) • Stand-by vessel (3-4% of budget) • Unplanned work and its planning cost

Discussion of findings

Based on the case study findings it is apparent that clear goals, scopes and objectives are essential for implementing and executing a service strategy. In the contract comparison it was observed that the contracts were similar with respect to content and structure. However, two major differences appeared. But in the M&M contract case, the service provider/customer relationship was more conventional[4]. One participant from the M&M contract stated that they provide "*seamless and transparent services where the customer sees the finished and installed product delivered on agreed price and time*". In the M&M contract the contractor charges payment on an hourly basis. In the PBO contract the contractor was rewarded based on performance. In addition, we found that the PBO contract's conditions seemed to be more flexible than those of the M&M contract.

The M&M case the service strategy concept implemented in the contract was a well tried over the last 10 years on the NCS and the company had considerable experience with executing the service delivery process. The PBO contract was a new and focus was tail-end production. This demands a different focus on costs and production regularity as compared to production from a field in a plateau phase. A

[3] Cost driver: a major part of an activity which dominates the total costs of the activity (e.g. high energy requirements, expensive distribution or intermediary, poor material quality, poor storage, high personnel cost, etc.), Kumar and Markeset, 2005

[4] For more details about different types of relationships see e.g. Grönroos, 2004; Gummesson, 1999; Eriksson et al. 1999; Berry, 1995; Christopher et al. 1991

large production facility operator may not have the capacity and willingness to invest valuable competence and resources necessary to obtain the cost cutting and improvement of operational and production effectiveness and efficiency needed for a production facility in the tail-end phase. These resources may be better employed at O&G production facilities delivering substantial more O&G volume and profits.

In PBO case during the service contract negotiation process neither of the parties had a complete overview of the planned and unplanned activities necessary to achieve the goals. However, the parties designed in contingencies to deal with the uncertainties through regular meetings, performance measures and contingency plans. Furthermore, the parties attempted to consider possible scenarios with respect to contract implementation and execution. It is advisable to consider services and scenarios that occur due to unpredictable failures and unforeseen events (see, for example, Kumar et al. 2004). During the implementation and execution process, one should monitor and reassess the performance to ensure that the cost drivers and performance killers are under control.

Excellent communications and transparency between involved parties, as well as clearly defined performance factors, play a vital role to create trust in the implementation and execution phase. Well-aligned communication and relationships are the foundation for trust- building between involved parties throughout the implementation and execution process. To become a successful strategy implementer and executer, the top management personnel should clearly communicate, "*what the new strategic decision is all about*" with involved parties and with operative personnel (Alexander, 1985). Any delay caused through poor communication or coordination could create conflict between parties and have an impact on business and relationships. Responsibilities and duties need to be clearly explained to reduce uncertainty, speculation and unfounded fears. The goal is to minimize the gap between required and delivered services, and to assure continuous excellent production assurance.

The service strategy implementation and execution process is complicated, but is important for the organization to compete in the market. There are several factors that need to be considered and continuously monitored to keep the implementation and execution process updated. Figure 4 illustrates a simplified service strategy implementation and execution process.

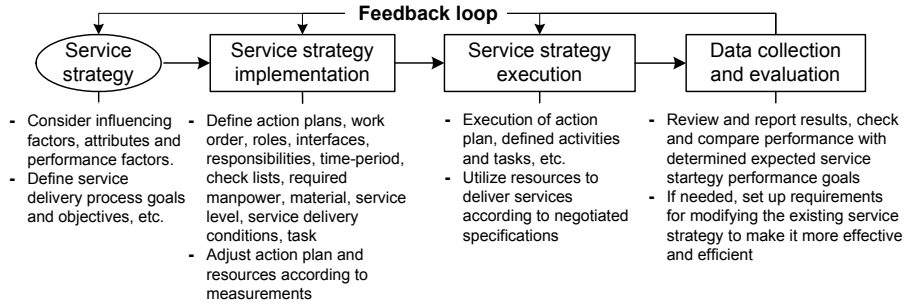

Figure 4 Service strategy implementation and execution process

Concluding remarks

To realize the objectives and to create maximum value for involved parties, the service strategy needs to be implemented and executed appropriately. Moreover, to achieve customer satisfaction and to create a win-win situation in the market, gaps between required and delivered services need to be avoided (Kumar and Kumar, 2004). Thus, a service implementation and execution framework that responds to the requirements of all involved parties is needed. Hiles (1994) asserts "*Whatever, service targets are set, they must be stretching but achievable. Under-promise and over-achieve*" seems to be the motto of successful implementers (also see Manarro – Viseras et al., 2005).

The service strategy developers, implementers and executors should clearly understand the process requirements and preferences. Based on this, they should be able to predict obstacles and prepare for possible solutions before the strategy is implemented and executed. Moreover, it is necessary to monitor what is actually happening to analyze how to deal with emerging problems, to seek solutions and to decide what modifications might be needed. When developing a contract implementation and execution model, implementer and executor attempt to consider all possible influencing and performance factors and to predict what services will be needed.

To ensure that a chosen strategy is effective as well as efficient, one needs to be aware of the related strategic and operational issues, challenges and opportunities that arise at various stages of the implementation and execution process as well as need to be flexible enough to adapt to changes to compete in the market. Services are based on relationships, finding solutions to customers' problems, and building relationships. The services' content is delivered in processes and driven by people.

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Paper VI

Markeset, T. and Kumar, R. (2005), "Cost reduction and performance enhancement through industrial support services – examples from Norwegian industry"

Submitted for publication in an *International Journal*

Cost reduction and performance enhancement through industrial support services – examples from Norwegian industry

Tore Markeset and Rajesh Kumar
Center for Maintenance and Asset Management
University of Stavanger
4036 Stavanger, Norway
Telephone: +47 5183 2191, Fax: +47 5183 1750
tore.markeset@uis.no

Abstract

Advances in hardware and software, sensors and sensory equipment, information and communication technology today make it possible to have two-way communication between the equipment/machines/systems and experts located far away. Remote equipment monitoring is possible by transferring data/information from equipment to appropriate information systems enabling performance diagnostics, prognostics and support. Operations, maintenance, and support (OMS) can be planned and supported at remote service centres based on updated data/ information and needs without physical inspection of equipment. The data/information can also be used for improving later designs and product support. In this exploratory paper, we will discuss how advancements in technology and work processes may be used to improve the performance of production facilities through improved operational, maintenance, and support service performance. The discussions are based on a research study including cases from three companies in Norway, which offer enhanced support at reduced costs and risk.

Keywords: Operation, maintenance, support services, remote equipment monitoring, industrial services

1 Introduction and background

During the past few decades industrial markets have grown in scope and become more globalized. The introduction of innovative technologies has transformed existing products and brought new ones into the marketplace. Moreover, as production systems become more advanced and complex, many owners/operators find themselves needing more support to operate and maintain production assets because it becomes more difficult and time-consuming to diagnose failures and faults. Operations and maintenance processes are becoming increasingly important for companies to operate at expected performance levels at lowest costs and risks.

Advances in control systems, instruments, sensors, software and reliable and secure data transfer using, for example, broadband fibre optic cables, as well as secure communication links, have opened up new avenues for development in the field of online equipment condition monitoring and system control. This technology may improve operations and maintenance management, logistics and repair actions, as well as enable the user to work with key issues at site, to reduce costs and to save time. By using the technology, an expert can follow the performance of the equipment from afar and provide the best operation and maintenance support. This can enable operators to make better decisions based on improved information and advice. Asset performance and failures can be predicted and diagnosed faster and more reliably than before. The implications are that it can change operational, maintenance and support strategies in ways that have never before been possible. It also should enable service providers, in collaboration with service receivers, to develop more effective and efficient service strategies to reduce systems life cycle costs (LCC) and to increase life cycle profit (LCP). (For more details, see Markeset, 2003, and Kumar, 2003).

The importance of remote monitoring is highlighted by many authors (see e.g. Küssel, et al., 2000, Rao et al., 2000, Lee, 1998). The attributes of, for example, a Teleservice[1] Engineering System (TES) includes integrated maintenance and production, responsive service distributed over networks of cooperating facilities, and teamwork among geographically and organizationally distributed units. By applying remote monitoring, traveling cost and time can be dramatically reduced as the failure causes can be analyzed and the right spare parts selected before traveling to the equipment site. Koç, and Lee, 2000, assert that the advances in Internet and wireless communication technologies compel companies to "shift manufacturing operations

[1] In literature the term "Teleservice" is often used to describe the process of surveying equipment from afar (see e.g. Lee, 1998, Küssel et al., 2000, and others)

from the traditional factory integration philosophy to an e-factory and e-supply chain philosophy".

Smart OMS (operation, maintenance, and support) is to some degree in use in, for example, military operations (e.g. Kosovo, Iraq, and Afghanistan), space operations (e.g. Mars mission), medical operations and sub-sea operations. In military operations, unmanned airplanes are used to take e pictures of the enemy regions and send the data and pictures to the control room and the nearby tanks to set the targets. These airplanes have proved very efficient and effective in critical moments. In space, NASA impresses us with remotely operating unmanned robot vehicles on Mars to collect samples and data of the planet and bring it back to Earth. In medical science, there has been tremendous development in technology enabling, for example, the use of robots in surgery, body scanning technology, visualization using miniature cameras inside patients, as well as remote support by experts using live communication and visualization aids. In the O&G (oil and gas) industry, remote operated vehicles (manned and unmanned) have been used for a long time to assist in installation, inspection, maintenance, welding, etc. of sub-sea production equipment and pipelines.

In the O&G industry on the NCS (Norwegian Continental Shelf), facility operations and maintenance present many unique difficulties not usually encountered in other applications. This is mainly due to:

- Statutory requirements for safety are very restrictive (improper maintenance often leads to economic losses, affect HSE, and causes materials damage)
- The use environment is harsh and demanding characterized by heavy loads, low and varying temperature, humidity, wind, waves, and corrosiveness
- Maintenance logistics costs are relatively high due to high costs of storage and transportation between spare parts suppliers and the remote area, etc.
- Operation and maintenance are carried out by personnel with varying degrees of training, skills, and experience
- It is much more difficult to perform a maintenance task in the adverse offshore environment than in a normal and friendly environment

In addition, industrial products/systems/equipment are becoming increasingly advanced and complex, and need to be operated continuously. Production facility downtime on an offshore production platform can be very costly due to lost production. Equipment performance and operational procedures therefore need to be carefully optimized to ensure total process performance (see e.g. Liyanage, 2003). Similarly, the maintenance and service support processes need to be optimized to ensure lowest possible costs in case of failure. Smart OMS (e-operations, maintenance, and support) is becoming a new and innovating way to make production more cost- effective, by improving production equipment performance, reducing operational and maintenance costs and risks. Additionally, Smart OMS involves effective and efficient use of human factors (personnel performance), organizations

and technology, and facilitates the achievement of improved and integrated system performance faster and better as shown in Figure 1.

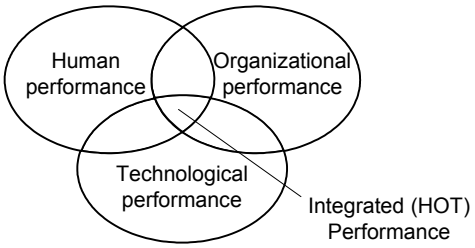

Figure 1 Integrated human, organizational, and technological performance

Petoro, a company which manages the ownership on behalf of Norwegian state O&G assets the on NCS (see also www.petoro.no), underlines that one of the advantages of Smart OMS is its cross-functional potential. Smart OMS using e-solutions is about integration of solutions at corporate, intermediate and asset levels in organizations. At the highest level, the focus should be on solutions that create value across assets (e.g. data and information management, infrastructure, web/portal solutions, links between front and back office applications, and capitalizing on patents) and on business opportunities across assets in exploration and production (e.g. portfolio optimization, acquirement of new assets, patents). At intermediate level Smart OMS is about demonstrating cost/benefit of a group of single point solutions within drilling, production optimization and maintenance of a single asset. At this level it also should assure holistic work processes, i.e. processes that assure data safety and regularity, integrate measurement involvement of relevant stakeholders and risk handling in the decision process, and improving operations rooms to assure optimized process control. To take full advantage of Smart OMS when designing new operating rooms, one first has to analyze gaps between future needs and existing processes, and thereafter design the new operating rooms based on a risk and opportunity decision analysis. At the lowest level, Smart OMS should enable qualification and demonstration of cost/benefit of single point solutions, and demonstrate cost/benefit of specific solutions at asset level.

Based on this background, we will present three cases of current industrial practices in Norway. Furthermore, we will discuss the findings with respect to implementing Smart OMS, to enhance production performance, and to reduce costs and risks.

2 Some examples of current practices

As many of the O&G fields on the NCS are reaching maturity levels and the tail-end of production life cycle, the industry is focusing on reducing costs. Furthermore, the companies are seeking better and more cost- effective technology and service solutions to develop small and marginal fields, as well as fields located at remote and sometimes Arctic locations. This has forced the companies to change focus and operational strategies and has forced them to look into new and innovative ways to reduce costs, to improve performance, effectiveness, efficiency, etc. and to better employ scarce resources. Therefore, the industry is focusing on using Smart OMS to extend the production of oil and gas fields at reduced costs and risks, without compromising health, safety and environmental (HSE) performance. They are also re-evaluating their core business focus and are increasingly outsourcing non-core activities to specialist service providers. In Norway, there has been an increased focus on developing Smart OMS as a tool for achieving visions and goals as well as improving competitive strength. Several studies delineate strategies for developing "E-Operations" as a competitive operational strategy for reducing costs and improving performance (Lilleng et al., 2004, and Lilleng et al., 2003). The following examples highlight some of the technology and processes employed.

Drilling operations on offshore platforms are very costly, both in terms of equipment capital costs, and in equipment itself. Equipment failure can result in huge losses in production time, as well as costly repairs. The drilling personnel need very specialized training, and skills. Other experts are needed to interpret data from down-hole sensors to decide on drilling progress. However, many of these experts are only needed intermittently, resulting in inefficient use of their capabilities. Therefore, many of the operators are insourcing these specialists from service providers at competitive rates.

2.1 The ConocoPhillips "Onshore Drilling Centre"

ConocoPhillips (Stavanger, Norway) started the operation of the "Onshore Drilling Centre" (ODC) in January 2003 in an attempt to reduce costs, risk, and at the same time to increase the performance of the very expensive and critical drilling operation on fixed platforms. The cost of developing and establishing the centre amounted to USD 4.4 Million (NOK 30 Million), but these costs were paid back in only seven months. After ten months of continuous operation, they had seen savings of more than USD 48.8 Million (NOK 60 Million). The onshore part of the centre consists of three rooms (an operation room, a meeting/collaboration room, and a large 3D (three dimensional) visualization room) separated by glass walls. In the drilling operation room six big display screens, side by side, are used to view real-time data and live video monitoring of the drilling process as shown in Figure 2.

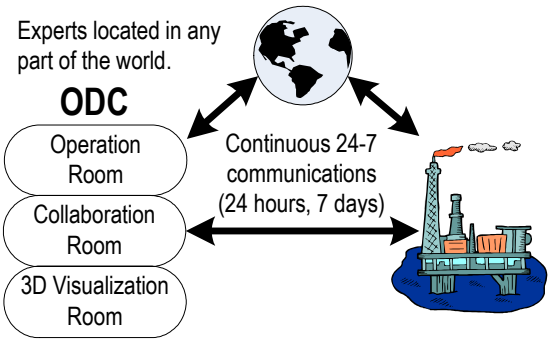

Figure 2 ODC communication and networking

The operation room is manned 24 hours a day, 7 days a week (24-7). They not only collect surface data, and data from the platform drilling equipment, but also down-hole data from various MWD (Measurements While Drilling) sensors located in the drilling tools. Image data from CCTV (closed circuit television), videoconference systems and a portable video system running on a wireless network is also utilized. All this information is transferred from the platform through reliable and secure fibre optical cables ensuring enough bandwidth at all times. However, on floating platforms the data is transmitted using satellites. This is a slower and more costly process. Many of the fixed offshore platforms are now connected using fibre optic cables, enabling the centre to support drilling processes at several platforms simultaneously. The centre is built mostly using standard, but high-end off-the-shelf equipment/technology. The data and information are displayed and analyzed in various applications, including those within the 3D visualization room.

Many so-termed 'data-focused' offshore engineers have been moved onshore – now doing their job remotely from a support centre. Direct connectivity between personnel is replaced by communication technology such as UHF (walkie-talkies), videoconference, wireless cameras, Internet, etc. As many of the process control parameters are available in real-time, the onshore specialists can assist in changing/ reprogramming equipment parameters to improve the operation performance. In this drilling process control room, experts in drilling operations, geology, geophysics, etc. work together with the offshore personnel and personnel located other places in the world, in a virtual team viewing the same real-time data. This enables much more effective and efficient multidisciplinary and cross-functional work and decision-making processes, enabling them to make faster and better decisions regarding the ongoing drilling process. If a problem occurs, they can discuss and take the required actions. This type of working environment enables an excellent communication

process and encourages cross-functional teamwork in a much more effective and efficient way than if they were located in their offices far apart.

In the case of a topside equipment problem they also have the possibility to use a specially designed video camera and communication equipment to perform remote inspection. This allows live pictures of the equipment to be viewed remotely in the ODC real-time. The camera can, for example, be mounted on the repair specialist's helmet to transmit live pictures to the onshore experts. This allows the diagnostics process to become much more efficient, minimizing downtime.

Specialists, who earlier had to be present at the offshore platform, can now have a normal 0800-1600 day-job in a comfortable environment. These specialists often had to stay on the offshore platform for longer than expected due to delays, weather conditions, etc., during the drilling process, with the result that their competence could only be used a small portion of the time. Now, they have the possibility to employ their extensive knowledge in a much more effective way, making their job much more interesting, and thus increasing employee job satisfaction. They can also use their knowledge to support several drilling operations simultaneously, thus making much more efficient use of their expertise. Furthermore, the onshore centre also enables ConocoPhillips to take advantage of expert competence in situations when the expert cannot travel offshore due to for example pregnancy, illness, small children, etc.

The Onshore Drilling Centre also has the possibility to employ expert support from other locations anywhere in the world if needed, as shown in Figure 2. For example, during the night the specialized onshore support can be provided by a similar centre (e.g. a remote support centre) located in Alaska. It also is possible to located similar centres at such locations in the world that all of the experts can work normal day shifts, eliminating the need for evening and night workers. Thus, one is able to use the time difference to provide 24-hour support services.

What's more, the drilling centre is set up so that in the future it can be linked to equipment or machinery support centres worldwide using secure hardware and software. These could be experts from the OEM (Original Equipment Manufacturer), internal experts sitting at other locations, or experts hired in from specialist support companies. This enables more effective and efficient support by the manufactures of the advanced, complex and expensive equipment/product as well as delivering diagnostics, prognostics, managerial, administrative, and logistics support needed in the case of product malfunctioning (also see Markeset, 2003, and Mathieu, 2001).

ConocoPhillips sees savings in improved drilling operations, improved utilizations of the expert's competence and skills, reduced offshore transportations using helicopters, reduced number of offshore beds employed at high costs, reduced health

and environmental risk, and increased safety. They have managed to help break down barriers between offshore and onshore personnel, and between internal and external support personnel (for example, between departments and with the service providers).

2.2 The RC-DEI "Online Condition Monitoring Centre"

The machine and/or system of a production plant can fail due to small, but very critical problems that can affect the whole production line. It can, for example, happen due to lack of awareness and knowledge of the particular failure mechanism. Condition Based Maintenance (CBM) has been used to avoid this unscheduled downtime, by monitoring the machines/systems performance/condition. With advances in telecommunications, it has now become possible and cost-effective to monitor these systems online. The valuable outcome from condition monitoring is problem diagnosis and performance prognosis (Rao et al. 2000). Often, when failures occur the maintenance specialist finds himself lacking knowledge of the equipment failure, with the result that correct diagnosis of the failure is difficult if not impossible and the necessary spare parts are not ordered or available. In either case, the result is increased downtime. However, by using technology advancements, RC-DEI AS, based in Stavanger and working directly for BP Norge, is attempting to reduce downtime and to improve performance through improved equipment monitoring and Proactive Reliability Maintenance.

They have designed and implemented a control room for the monitoring of offshore equipment located in the North Sea. In this control room, they use cameras to view the machine and at the same time receive online data from sensors fitted to the critical items. They use offline and online vibration technology, thermodynamic performance analysis, lubrication oil analysis and phase-current analysis for monitoring the equipment condition as well as electronic data handling for processing data. With the help of these systems, one can monitor the health of the machine to perform diagnostics and thereafter for prognostics. The data is trended and analyzed by experts, and by comparing the information case by case with historic information, they are able to predict pending failures.

RC-DEI reported that they had experience with other operators in the North Sea apart from BP Norge, which indicates that the running cost of the whole program for a typical offshore platform is variable, depending on the number of problems detected, and the level of specialist call-offs to assist with balancing, alignment, etc. However, averaged over the last two years it comes to USD 250 000 (NOK 1.7 Million). When looking at cost savings, figures can easily mount up. A recent compressor failure case from an offshore platform operated by one of the companies on the NCS not using CBM techniques, shows that downtime costs amounted to 8000 barrels of lost production per day. With an oil price of $ 27 per barrel the cost savings would have been $ 216 000 per day (NOK 1 887 840). This compressor was out of

operation for 18 days while RC-DEI engineers performed post failure system diagnostics, spare parts were obtained to repair the failure, and the unit was balanced following reassembly. To date, since the operation of the onshore data handling room, no similar failures have been suffered.

In addition, there are costs associated with maintenance repairs delays because of administrative procedures, regulative procedures, logistics, etc. For sub-sea installations, the costs are much higher. In many cases, there are also other failure-related costs such as secondary consequences, start-up and run-down, recalibration, etc.

2.3. The CHC Astec "Integrated Logistics Support Control Centre"

CHC Astec, Stavanger, (part of the Canadian Helicopter Corporation Group) performs maintenance planning, component repair/overhaul, helicopter customizing and ILS (Integrated Logistics Support) services on 100 helicopters today used worldwide, producing 100 000 flight hours annually in global operations and in geographically remote sites. The customers varied from Governmental/Military and stand-alone companies in SAR operation (Search And Rescue) and Oil and Gas Exploration and Production. In the North Sea the helicopters operated by the CHC Group are mainly used for transporting offshore personnel, mail, and goods from onshore heliports to platforms located all over the North Sea. Helicopter maintenance is performed under strict regulations imposed by Norwegian and international authorities, and therefore needs to follow very specific procedures. Much of the helicopter maintenance has to be performed in between flights. Hence, the maintenance has to be very well planned and executed in a timely, effective and efficient manner. In addition, the maintenance personnel need to be very well trained and skilled. Consequently, maintenance management is a very critical process. Maintenance management controls all the activities related to the maintenance (e.g. processes like action plan development, maintenance execution, logistics support, inventory management, operator training, etc). Procurement, inventory, and logistics of spare parts are one of the most critical support processes. Helicopter spare parts have to conform to very strict regulative rules encompassing physical specifications and documentation, as well as the recording of historical data.

CHC Astec started to use the "Integrated Logistics Support Control Centre" (ILS Control Centre) in 2000 to improve and integrate the processes related to maintenance planning, procurement, storage, and logistics of spare parts. The centre functions as a control room for the work processes related to integrated spare part logistics. Personnel in charge of spare parts purchasing, planning of maintenance activities and creation of work orders, spare parts shipment, documentation, storage, etc. are located in one room facing a screen displaying all related information. Their customers are offered various types of contracts, varying from simple ad-hoc component repair

contracts and component overhaul contracts, to comprehensive and all-encompassing total-care-solutions contracts (also called full support or what sometimes are referred to as power-by-the-hour contracts). Helicopter customers' requirements are dependent on type of operation and operational requirements, geographical location, etc.

The information is continuously updated as the status of the orders is changing, and new orders are added. Warnings are displayed immediately if a shipment is delayed according to a plan, or if, for example, a spare part is out of stock. The software tool utilized is developed and maintained by CHC Astec and is still under development. Personnel can communicate directly with others in addition to using ICT (information and communication technology) to interface with their suppliers and customers. One person has the main responsibility of controlling the ILS centre. This person also serves as a customer and supplier contact – thus having only one point of contact interface. Moreover, it also results in continuously updated case information and reduced confusion and conflict related to duplication of information.

So far, the results show that the utilization of helicopters has improved by 60% by downsizing the helicopter fleet and maintaining the same number of flight hours. The ILS thinking has made the logistic support process much more effective and efficient through improved communication, work processes and control. From 1988 to 2002, the number of helicopters supported increased from 42 to 101. Yearly flight hours increased in the same period from 33 000 to 99 000. At the same time, the number of spare parts supported reduced from USD 100 Million to USD 75 Million. Other important key factors that show further business development for the customers are:

- Direct maintenance cost reduced by 30%,
- Inventory held and owned by customer reduced by 80%, and
- Spare part availability increased by 4%. One key factor in this area is that all negotiation leverage is joined up in Astec ensuring low Turn Around Time (TAT) and price versus. OEMs and vendors.

The centre cost approximately USD 147 000 (NOK 1.0 Million) to develop apart from the software development costs. In consumable parts alone, the company achieved additional savings of USD 3.7 Million (NOK 25 Million) last year. In total, ILS contributes approximately 68% to Astec business and turnover. The company reported last year that it had experienced a helicopter service level above 97% of that required. This year the new target is set at 98.5%. In addition, the company reports that helicopters held by customers/ operators had reduced "take-off" delays to less than 3%. One of the largest customers reported (over 12 months, rolling) that of 12 699 flights performed, they had 44 delays (more than 15 minutes related to agreed take-off time). Of these 3%, 0.35% was related to Astec ILS and 2.24% was due to the operator himself.

The ILS centre, monitors systems and flying platforms for assessing the requirement of spares and other resources like repair manpower, depending on the health status of the helicopter. This can facilitate planning for taking in new repair jobs, postponing maintenance and repair plans as per the customer's requirement, and provide a clear overview of incoming machines with problems. The ILS Centre facilitates automatic ordering of parts and components based on assessment made using helicopter health data and front-end processes where customer requirements are integrated. Thus, the ILS Centre integrates back-end processes, like supply chain management as far as spare parts are concerned, and front-end processes, as far as customers' requirements are concerned, using ICT capabilities.

3 Discussion

All three cases show that the integrated remote support concepts have resulted in substantial costs savings and increased availability of critical and capital-intensive physical systems/equipment/machines performing highly critical and expensive operations. Several other O&G companies operating on the NCS are developing similar centres for remotely supporting the operations of their offshore facilities. ConocoPhillips for example, are developing two other centres for supporting their offshore operations. The helicopter operator CHC Astec has developed a similar centre for controlling flight operations.

What makes all this possible is the use of advanced ICT for exchanging large amounts of data in real-time, the integration of personnel with various multidisciplinary expertise in virtual teams enabling cross-functional communication, and not the least, the use of effective and efficient information visualization methods. By using emergent ICT technology, remotely located plants can be supported by centralized and decentralized support centres on a continuous basis as shown in Figure 3. The solid arrows indicate main communication lines, whilst the dotted line indicates direct communication links between the internal/external experts (e.g. OEM expert) and users. This enables a more effective and efficient support and decision-making process in critical situations.

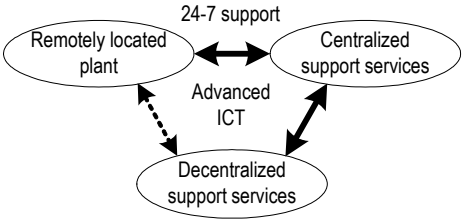

Figure 3 Generic support structure employing virtual teams and advanced ICT

Smart OMS is dependent on combining knowledge, information and data in a smart way and using it intelligently. In the three cases presented standard off-the-shelf products are used in the centres. Only in the CHC Astec case, a special software tool has been developed to enable the process.

Representatives for the companies report that one problem in utilizing this type of support centre is not finding the necessary hardware or technology – the challenges encountered are heavily related to human and organizational factors. They also emphasized that sensors, instruments, and interfaces, as well as software tools, need to be developed to control and monitor operations better, to improve maintenance and support, and to reduce associated costs (see also Figure 1).

In the study of the ConocoPhillips support centre, it was observed that many of the employees (occasionally up to 80%) came from collaborating service companies. Moreover, it was observed that many of them came from different departments and disciplines. Even though there were many advantages in this, there also were disadvantages. Some of them included difficulties in communication between personnel from different disciplines, information overflow, ineffective and inefficient visualization of information, confusion in communication due to use of non-standardized terminology (talking about the same thing using different words, or talking about different things using the same words).

Other issues, which need to be resolved are the creation of more effective and efficient organizations to enable collaboration of remote support centres. With respect to performance, it was observed that the big challenge is to negotiate collaboration agreements that enable optimized performance. Work processes and performance measurement systems need to be designed to integrate and structure human, organizational, and technological performance.

New and better ways need to be developed to distribute, store, use, present, and visualize the information in such a format that the critical information is visible for the right people at the right time in the right format, and not hidden in a mess of unimportant and noisy information. The goal must be to present the information in such a way that the cross-functional decision-makers can make better decisions faster with reduced risks.

Furthermore, it was observed that companies were reluctant to discuss remote control of offshore technical processes. It was mentioned that there are issues with respect to health, safety and environment that need to be clarified and resolved.

With respect to enabling remote equipment monitoring, it was mentioned that there need to be developed improved sensors, diagnostics and prognostics tools and

methods, as well as improved ways to transport the sensor information to the analysis tool (wireless technology, broadband, analysis and filtering in sensor, embedded sensor calibration, etc).

The findings are supported by other studies performed in Norway (see Lilleng et al., 2004, and Lilleng et al., 2003). It is highlighted that some of the challenges related to Smart OMS include:

- Information management, visualization and communication
- Human, organizational, and technological, (HOT) challenges
- Condition monitoring and diagnosis
- Technical integrity and safety

Lilleng et al. (2004), furthermore emphasize that "The major challenges in this development will be to sustain and improve the technical safety level, increase the operation regularity, ensure and develop the organization and competence and document the robustness". Moreover, efficient use of for example, maintenance data and creating more effective work processes will have to involve system and service support providers as well as original equipment manufacturers.

4 Concluding remarks and future work

The advancement in ICT has made it possible to remotely inspect, supervise, and control processes away from the production or operation site round the clock and have opportunity to use experts from different parts of the world. One of the problems is that too much information is collected and stored, but unfortunately is used neither very effectively nor efficiently. By selecting and routing the right information to the right people at the right time, this situation can be improved. By combining the advancements in ICT, sensory equipment and control systems, with the concepts of integrated decision making processes, teamwork, supply chain management, etc. we can make better decisions faster and cheaper at reduced risks.

With the help of technology advancement, the operator and maintenance experts can make better decisions based on improved communication, information, and documentation. It also enables companies and organizations to improve the performance of operations, maintenance, and support processes, to become more competitive at a global scale, and to increases profits. The Smart OMS concept enables the operators to make critical decisions in critical situations at a critical time based on critical information and critical communication.

This is especially important in the tail-end of O&G reservoir depletion phase (late life phase) where costs and potential profits through extension of production period are highly dependent on the ability to reduce operational expenses (OPEX) and/or to

increase recovery. High OPEX combined with falling production levels results in increased unit costs (production cost per unit O&G produced) (NPD, 2003). To continue production the unit costs need to be reduced or the production increased. Increased recovery is only possible through enhanced O&G recovery techniques, and/or through connecting marginal fields located close to existing production facilities within the service life of the production installations and infrastructure. Unfortunately, in many cases the only way to extend the production period is to reduce OPEX.

To reduce OPEX is difficult since one has to start the well planning in advance of the tail-end phase. Furthermore, one needs to involve all the companies and expertise available for maximizing equipment and system performance, to minimize losses, and to reduce risk. This means that all involved companies need to cooperate and develop a common service strategy based on a common understanding of production asset performance. The only way to continue to deliver support services for an extended period is to cooperate with the operator to reduce costs. In the North Sea there are examples of companies which focus on being experts in facilitating extended production based on reduced OPEX.

Research needs to be initiated to develop performance-based service strategies, where all involved parties focus on optimizing production facility performance (asset performance) by considering all factors that will influence the strategy implementation and execution. All participants need to understand that it is the production facility, that generates value for all parties and therefore all parties need to cooperate to optimize the production performance.

Furthermore, such a service strategy needs to employ a performance measurement system to assess the service performance on a periodic or continuous basis to reduce gaps between required and actual delivered support. The goal is to create a win-win situation for both the service provider and receiver. Moreover, studies need to be undertaken to develop effective and efficient service delivery strategies to take better advantage of expert knowledge located for example at the OEM or at service providers.

Acknowledgement

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Part III – Appendices

Appendix I
Service delivery strategy

Service delivery strategy

Purpose of the survey

This survey is conducted for the purpose of a Research Study being pursued at the Division of Operation and Maintenance Engineering at LTU with a focus on service delivery strategy. The main purpose is to study the service delivery practices in the manufacturing/service companies.

Goal of the project

To develop a framework for service delivery strategy for industrial product in a global market perspective

Introduction

High quality of service and product support plays a key role in enhancing performance, effectiveness and efficiency of both high technology and conventional engineering products. All customers expect prompt and efficient service when the system is not performing as expected. Without proper service and support, it is impossible to realize the maximum value from the product and processes as customer often fails to realize products full capacity and capability and finds it hard to run without interruptions. To fulfill the customers' requirements manufacturer/service provider develop the service delivery strategy and deliver the services as per requirements. Service delivery strategy can be defined generic overall plan for achieving the service goals that also considers elements that can affect goal achievement.

Preliminary information

Date: _____

Place: _____

1. Name of the organisation:

2. Type of organisation:

3. Designation:

4. Job specification:

5. Working since (on same post):

6. Working experience:

7. Total turnover of your organisation (approx per year):

8. Total turnover for product support and service work (approx per year):

9. Contact information
   - Tel: _____
   - Fax: _____
   - E-mail: _____

Note:

Shall we mention Your Company name in report

Yes ☐ No ☐

If you feel there is not sufficient place for writing comments then feel free to add the paper sheet

Do you have written service delivery strategy in your organization?

Yes ☐ No ☐

Comments (if any):

---

1. Do you have same service delivery strategy for all customers?

Yes ☐ No ☐

Comments (if any):

---

2. Do you develop customized service delivery strategy?

Yes ☐ No ☐

Comments (if any):

---

3. While developing service delivery strategy
   - do you consider reliability[1] and maintainability[2]?

Yes ☐ No ☐

[1]Reliability is measured by mean time to failure (MTTF) or mean time between failure (MTBF)

[2]Good maintainability facilitates part/ component interchangeability, provides easy accessibility, is easy to service and is modular in design. It is measured by mean time to repair (MTTR).

Comments (if any):

---

4. While developing service delivery strategy
   - do you consider operating environment?

Yes ☐ No ☐

Consideration for tough operating climates (e.g. too cold, hot and moisture, humidity etc)

Comments (if any):

---

5. While developing service delivery strategy
   - do you consider operational requirements?

Yes ☐ No ☐

Schedule and volume of the production (e.g. 24 hours a day, 7 days or 5 days in a week)

Comments (if any):

6. While developing service delivery strategy
   - do you consider geographical location of the customer?

   Yes ☐ No ☐

Whether location of customer is in remote area or in the place which is easily accessible

Comments (if any):

---

7. Do you deliver product support and service using your own organisation?

   Percent ☐

   Yes ☐
   No ☐
   Mixed ☐

Comments (if any):

---

8. Do you prioritize work order?

   Yes ☐ No ☐

If Yes then on what basis?

Comments (if any):

---

9. While developing service delivery strategy
   - do you consider customers' service and maintenance strategy

   Yes ☐ No ☐

Comments (if any):

---

10. While developing service delivery strategy
    - do you consider your own organizations delivery capability?

    Yes ☐ No ☐

Comments (if any):

---

11. Do you conduct any training programs for your own employees to enhance skills?

    Yes ☐ No ☐

- customers' employees to enhance their skills?
  Yes ☐ No ☐

Comments (if any):

---

12. Mode of information flow

	Percent
Verbal	☐
Written	☐
E-mail	☐
Mixed	☐
Others	☐

13. Do you use performance indicators for measurement of service and maintenance performance?
    Yes ☐ No ☐

If Yes, then list five important performance indicators

---

14. Do you collect any feedback data?
    Yes ☐ No ☐

Do you analyze and use feedback to improve the service delivery strategy?
Yes ☐ No ☐

How often you undertake this exercise/task?
Monthly ☐ Quarterly ☐ Half yearly ☐ Others ☐

Comments (if any):

---

15. Do you measure the customer satisfaction?
    Yes ☐ No ☐

How do you measure?
Survey ☐ Interview ☐ Repeat work order ☐ Others ☐

Comments (if any):

Appendix II
Negotiation of service contracts

Service delivery strategy

Negotiation of service delivery agreements

Purpose of the survey

This survey is conducted for the purpose of a research study being pursued with a focus on service delivery strategy for advanced industrial products. The main purpose is to study the service delivery practices and the service delivery negotiation process and its influencing factors as found in industry. We focus on advanced integrated industrial products/equipment/machines used in a multinational environment. Moreover, the focus is on the after sales relationship between manufacturing/ service companies and their industrial customers.

Introduction

High quality of service and product support plays a key role in enhancing performance, effectiveness and efficiency of both high technology and conventional engineering products. To fulfill the customers' requirements, the manufacturers/service providers develop the service delivery strategy and deliver the services as per requirements and negotiated agreement. Furthermore, to achieve customer satisfaction and customer's retention, one has to negotiate service agreements. A successful negotiated agreement could create a win-win situation for both parties (user and supplier). The negotiation process helps in defining the required product support and how they are to be delivered. On the basis of the negotiated terms and conditions, one can develop a service delivery strategy. A service delivery strategy can be defined as a generic overall plan for achieving the service goals that also considers elements that can affect the goal achievement.

Based on our field experience gained through R&D projects and literature surveys, we have developed a conceptual framework for delivery of competitive and effective services, considering critical negotiation parameters.

NOTE: Please read the definitions of expressions used in the survey before answering the questions. If you disagree with the definitions, please explain.

Maintenance: It is defined as a combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, as state in which it can perform the required function. Services like lubrication, cleaning, oil and filter change, and calibration, adjustments, etc. are included in the maintenance concept.

Maintenance support: Resources, services and management necessary to carry out maintenance. (Support may include, for example; personnel, test equipment, workrooms, spare parts, documentation.)

Maintenance supportability: The ability of a maintenance organization of having the right maintenance support at the necessary place to perform the required maintenance activity at a given instant of time or during a given time interval

Product support: Product support can be defined as any form of assistance that companies offer to customers to help them gain maximum value from the manufactured products. It is commonly referred to as after-sales service, customer support, technical support, or simply as service.

Services to Support the Products: Services to support the products can be defined as services needed to ensure a product's functional performance. These services are governed by the product's functional weaknesses. It includes support services such as maintenance, repairs, spare parts, expert advice, diagnostics, etc.

Services to Support the Customers: Services to support the customers can be defined as services intended to support the client's actions in relation to the product. They include services such as advanced training, performance analysis, operations and maintenance strategy development, etc. This kind of service is governed by customer's and manufacturer's knowledge, expertise, as well as their wants, needs, and preferences.

Service Delivery Strategy (SDS): A generic plan for achieving the service delivery goals. This defines what is to be achieved in terms of services, what is to be delivered, how to deliver them based on considerations of product characteristics, operating environment, operational requirements, customer characteristics and preferences, geographical location, etc. The plan should as well define how to measure the service delivery performance. The plan should have a general section for all customers and a specific section for customers with special needs.

Service Reception Strategy (SRS): A generic plan for achieving the service reception goals. The SRS is developed by customers/ service receiver and defines how to receive the services provided by service supplier so as to maximize the value added. The plan should as well define how to measure the service reception performance. The plan should have a general section for all suppliers and a specific section for products with special needs.

Note: We define product support as a service divided into services to support the products and services to support the customers. Thus, when we talk about service delivery (reception) strategies we mean strategies for delivering (receiving) product support.

Definitions (Ref. Markeset, T. (2003), "*Dimensioning of Product Support: Issues, Challenges and Opportunities*", Doctoral Thesis, 2003:6, University of Stavanger, Stavanger, Norway, ISBN 82-7644-197-1.

Preliminary information

Date:

Place:

Name of the organisation:

Part of a group (parent or subsidiary):

Type of organization (what is the primary and secondary purpose of your company):

Position in company:

Job specification:

Working in current position since:

Working experience:

Total financial turnover of your organisation (approximate per year):

Total financial turnover for product support and service work (approximate per year):

Contact information:

Tel:

Fax:

E-mail:

Note: Can we mention your company name in the report? Yes:___No:____

In the scenario described on page 1, are you a manufacturer (___), customer/user/owner (___), or intermediate service provider (___) of advanced industrial products? Please explain the primary function of your company:_____

Please feel free to add comments on a separate sheet if there is not sufficient place in the questionnaire.

Questionnaire – Part 1

1: What do you consider to be an advanced industrial product? Please mention examples of such products you purchase or sell.

2: What services (product support/ after sales support) are normally included with such products?

3: To what extent are the services delivered by an intermediate organization or by the original equipment manufacturer (OEM)

4: Is product support negotiated together with the product?

5: At what time (life cycle phase) do you negotiate product support?

6: When negotiating product support, do you also include upgradation and modification services?

7: What do you consider is the key content in a service delivery agreement for advanced industrial products?

8: What factors can destroy a negotiation process and create conflicts?

9: Do you consider outsourcing in your business strategy? If yes, please elaborate on your answer and also describe what kind/type of outsourcing you use.

10: How do you measure the performance of the service delivery process for advanced products during the service life?

Questionnaire – Part 2

11: What are the 5 most important types services you think should be included in an agreement of product support and delivery of these services?

1:

2:

3:

4:

5:

Comments:

12: What are the 5 most important factors you consider when negotiating an agreement for delivery of services?

1:

2:

3:

4:

5:

Comments:

13: What do you consider to be the 5 most critical process factors with respect to success in a service delivery negotiation process?

1:

2:

3:

4:

5:

Comments:

14: What are the 5 most important factors that influence service delivery?

1:

2:

3:

4:

5:

Comments:

15	Do you go through a formal negotiation process with your customers before going into a service delivery agreement? If Yes, please explain!	Yes No	
	Comment (if any):		
16	Do you have a written procedure for the negotiation process? If Yes, please explain!	Yes No	
	Comment (if any):		
17	Do you practice customized negotiation processes? If Yes, please explain!	Yes No	
	Comment (if any):		
18	Do you have any special training in your organisation to develop negotiation skills? If Yes, please explain!	Yes No	
	Comment (if any):		
19	While you are negotiating are you giving any options to renegotiate if initial negotiation fails? If Yes, please explain!	Yes No	
	Comment (if any):		
20	Do the service agreements contain criteria on performance measurement of the service delivery process?	Yes No	
	If Yes, please mention some examples of service delivery performance measures.		
	1:		
	2:		
	3:		
	4:		
	5:		
	Comment (if any):		

21 While developing a negotiation strategy for delivery of services (product support) for advanced industrial products, do you consider (Please mark all relevant alternatives):

Planned services	☐	
Unplanned services	☐	
Services related to product characteristics	☐	
Services considering customer characteristics	☐	(For a service provider)
Services considering provider characteristics	☐	(For a service customer)
Warranty services	☐	
Price	☐	
Performance	☐	

Comments (if any)

22 While developing a negotiation strategy for delivery of services (product support) for advanced industrial products, do you consider (Please mark all relevant alternatives):

Customer's requirements	☐	(For a service provider)
Provider's requirements	☐	(For a service customer)
System's requirement	☐	
Your own capabilities	☐	
Customer's capabilities	☐	(For a service provider)
Provider's capabilities	☐	(For a service customer)
Geographical location	☐	
Cultural aspects	☐	

Comments (if any)

23 Does your negotiation process deal with (Please mark all relevant alternatives):

Equipment delivery	☐
Service delivery	☐
Both equipment and service delivery	☐

Comments (if any):

Appendix III
Performance-based service strategy

Development of service strategy

Mapping of current practices and future needs

Introduction

This survey is conducted as part of an ongoing research study at Stavanger University College focusing on improving effectiveness and efficiency of operation and maintenance strategies for oil and gas (O&G) production installations on the Norwegian Continental Shelf (NCS). We especially focus on external and internal services needed to support (or perform) operation and maintenance activities. Examples of such services include:

- Insourcing of specialists to conduct work which is outside the competence area of the company (e.g. expertise from an original equipment manufacturer (OEM) needed to diagnose or repair an advanced equipment/ machine/ system)
- Outsourcing of a part of the operation or clearly defined activities because it is not part of the company's core focus area (e.g. maintenance and modification contracts, design of a new module)
- Outsourcing of large scale activities with extended scope as part of a business strategy (e.g. operation and maintenance of an entire platform in the tail-end phase)
- Delivery of services related to advanced product support (field service, spare parts, training, diagnostics services, remote support, etc.)
- Remote support requiring specialist services not normally at plant site

Purpose and goal

The main purpose of the survey is to map service strategy. To do this we first intend to define influencing factors and factors that build up influencing factors of a service strategy. To get a broad picture of the involved parties and stakeholders we focus the survey on service buyers/ customers. This includes production facility owners or operators (e.g. Statoil, Norsk Hydro, Conoco Phillips, BP, Talisman, Dong,

Marathon, Petoro, Total, etc.), engineering companies (e.g. Aker Kværner Offshore Partner, Aker Kværner Operations, Vetco Aibel, Halliburton, etc), consultant companies (e.g. C-Partner, DNV Consultants, Sørco, etc.), and OEMs (e.g. Frank Mohn, Framo Engineering, Kværner Oilfield Products, Camron, Nuevo Pignone, etc.). By doing this we should be able to map differences with respect to which factors different actors on the NCS consider in their service strategies.

Second, we intend to use the survey to identify differences between operations and maintenance strategies for platforms operating in the plateau and tail-end phase of the service life of an O&G field. Therefore, we intend to perform the same survey for employees working on four platforms: two in the tail-end phase and two in the plateau phase.

Third, we intend to map possible cost drivers, performance killers, and critical success factors through guided interviews of some experts in the filed.

Based on mapping the status and practices and the results we will build a model or framework for development of a general service strategy and a specific model for those platforms in tail-end phase.

Definitions

Service: Services are deeds, processes, and performance. Deeds are activities designed to solve problems which customers cannot solve them selves. Processes are identified approaches used to carry out deeds. Performance relates to how well a deed is performed, effectiveness and efficiency of quality (Zeithaml & Bitner, 2000)

Service Strategy: A service strategy is a plan for achieving the service goals of both the service receiver (buyer) and the service provider (seller). The plan states what services are needed (i.e. the service content and outcome), where they are needed (the location), how they are to be delivered (the service delivery process), when they are to be delivered and for how long time they are needed (timing and duration), to whom to deliver them and what resources are needed (personnel, skills, tools, equipment, etc.), and why the services are needed (the reason). The plan should also suggest approaches to fulfilling the defined service requirements to achieve the service goals, and define how to measure or evaluate the service performance.

Maintenance: It is defined as a combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, as state in which it can perform the required function. Services like lubrication, cleaning, oil and filter change, and calibration, adjustments, etc. are included in the maintenance concept (Norsok Standard, Z-008).

Preventive maintenance: Maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the function of an item (Norsok Standard, Z-008).

Predictive maintenance: Condition based maintenance carried out following a forecast derived from the analysis and evaluation of significant parameters of the degradation of the item (Norsok Standard, Z-016).

Corrective maintenance: Maintenance, which is carried out after a fault recognition and intended to put an item into a state in which it can perform a required function (Norsok Standard, Z-016).

Campaign based maintenance: Foreseen maintenance activities relatively high in work volume and carried out equivalent to a project (SDV – Indicator project)
www.his.no/sdv/project/terminologi.html#maintenance%20program

Opportunistic maintenance: Maintenance of an item that is deferred or advanced in time when an unplanned opportunity becomes available (British Standard, BS 3811:1993).

Immediate maintenance: Maintenance, which is carried out without delay after a fault, has been detected to avoid unacceptable consequences (British Standard, BS EN 13306:2001).

Reliability: Characteristics of an item expressed by the probability that it will perform a required function under stated conditions for a stated period time (Dummer and Winton, 1990, Norsok Standard, Z-016).

Maintainability: The ability of an item under given conditions of use, to be retained in, or restored to, a state, which it can perform, a required function, when maintenance is performed under given conditions and stated procedures and resources (Norsok Standard, Z-016).

Service Delivery Strategy (SDS): A generic plan for achieving the service delivery goals. This defines what is to be achieved in terms of services, what is to be delivered, how to deliver them based on considerations of product characteristics, operating environment, operational requirements, customer characteristics and preferences, geographical location, etc. The plan should as well define how to measure the service delivery performance. The plan should have a general section for all customers and a specific section for customers with special needs (Markeset, 2003).

Service Reception Strategy (SRS): A generic plan for achieving the service reception goals. The SRS is developed by customers/ service receiver and defines how to receive the services provided by service supplier so as to maximize the value added. The plan should as well define how to measure the service reception performance. The plan should have a general section for all suppliers and a specific section for products with special needs (Markeset, 2003)

Success factor: An influence factor which is decisive for success of an activity (e.g. competence and skills, marketing, input resource quality, sales and distribution channel, planning, etc.).

Cost driver: A major part of an activity, which dominate the total costs of the activity (e.g. high energy requirements, expensive distribution or intermediary, poor material quality, poor storage, etc.).

Performance killer: A part of an activity that influences processes in negative way even though they are not visible or strong (e.g. a process/ activity bottleneck, poor competence and skill, poor quality input material, poor tools, etc).

Outsourcing: Outsourcing is a term to describe the transfer or contract out of an internal activity/ process/ product to an external supplier.

Insourcing: Insourcing is a term to describe the process of using external experts to perform internal activities in a company.

References:

Dummer, G.W.A. and Winton R.C. (1990), *"An Elementary Guide to Reliability*", 4th ed., Pergamon Press, Oxford.

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British Standard, (1993), "Glossary of terms used in terotechnology", BS 3811:1993.

Preliminary information

Name of the person:

Position in company:

Job specification:

Working in current position since:

Working experience (years):

Name of the organization:

Part of a group (parent or subsidiary):

Type of organization (i.e., the primary and secondary purpose of your company):

Total financial turnover of your organization (approximate per year):

Total financial turnover for services:

Date:

Place:

Contact information:

Tel:
.

Fax:

E-mail:

Note:
Can we mention your company name in the report? Yes: ☐ No: ☐

Please feel free to add comments on a separate sheet if there is not sufficient space in the questionnaire.

Part 1: Mapping of existing practices

Confer definitions on page 2 for expressions and concepts used.

		Yes	No
1	Do you have any written service strategy for your organization? Please explain:		
2	Do you have same service strategy for all your customers/ suppliers or you customize? Please explain:		
3	Do you outsource services? Please explain:		
4	Do you insource services? Please explain:		
5	Do you involve specialized personnel when developing service strategies? Please explain:		
6	Do you collect data from your customers to modify and upgrade service strategies to make them more profitable, productive, effective as (and) efficient? Please explain:		

Part 2: Influencing factors of a service strategy

1. Please mark the degree of importance your company put on the listed influence factors. Confer definitions on page 2 for expressions and concepts used.

NOTE:
If you disagree about the influence factors listed, please explain why.
If you think there are other influence factors, please list them and explain them.

	Do you currently consider this influence factor?		Very high influence	High influence	Medium influence	Low influence	No influence
Influencing factor	**Yes**	**No**	**5**	**4**	**3**	**2**	**1**
Maintenance needs							
Observed conditions of the asset							
Age of the asset							
Technical characteristics of system • Reliability							
• Maintainability							
• Quality (output from product)							
• Functionality							
• Other (if any)							
Existing and future operation and maintenance practices							
Fluctuation in O&G production profile							
Other suggestions							
Operational environments							
Temperature							
Humidity/ moisture							
Corrosiveness							
Dust							
Wind							
Other suggestions							
Operational requirements							
Health (Issues which can impact long-term health of the employees and surrounding population, e.g. pollution, ergonomics, noise)							

Influencing factor	Do you currently consider this influence factor?		Very high influence	High influence	Medium influence	Low influence	No influence
	Yes	No	5	4	3	2	1
Safety (Safety of the workers and surrounding population e.g. accidents)							
Environment (e.g. pollution from product or production process, pollution from product at end of life)							
Expected service life of platform or system (Are there requirements with respect to modification and/or upgradation of platform/ system during lifetime?)							
Service buyer's requirements (System performance/ availability requirements, production schedules)							
Residual service life of assets (What is the residual design life of the asset and system? and what is the needed service life, etc.)							
Other suggestions							
Geographical location							
Cultural aspects (e.g. If you work in a foreign country, one need to know the local language or have common language for communication. Similarly, one needs to have knowledge about local business traditions, rules and regulation)							
Government legislation (e.g. Local taxes, insurance, terms and conditions for obtaining license, work permit)							
Infrastructure (e.g. transportation, power distribution, communication)							
Supply chain (e.g. logistics, local suppliers, service contracts)							

Influencing factor	Do you currently consider this influence factor?		Very high influence	High influence	Medium influence	Low influence	No influence
	Yes	No	5	4	3	2	1
Manpower (e.g. available workforce with right qualifications, skills and capability)							
Other suggestions							
Service seller's strategy							
Competence, skills, ability & capability							
Tools and methodology (e.g. What tools and methodology does the organization use to provide the services?)							
Service buyer's requirements • Manpower standard requirements (skills and qualification)							
• Quality requirements (what are the requirements of service product quality)							
• How do they measure the quality of services (by auditing or by using other methods for measuring service performance)							
Other suggestions							
Service buyer's strategy							
Service reception strategy (e.g. outsource jobs/projects, insource specialist personnel)							
Goal and objectives of the company (e.g. with respect to O&M strategy)							
Operational strategy							
Maintenance strategy • Preventive Maintenance							
• Predictive maintenance							
• Corrective Maintenance							
• Opportunity-based Maintenance							
• Campaign-based Maintenance							

Influencing factor	Do you currently consider this influence factor?		Very high influence	High influence	Medium influence	Low influence	No influence
	Yes	No	5	4	3	2	1
• Immediate Maintenance							
• Temporary maintenance (i.e. Temporary solution of non-critical systems, e.g. patching of pipes, welding)							
Flexibility of service seller							
Cost							
Reputation of service seller							
Other suggestions							
External factors							
Product price fluctuation (e.g. O&G)							
Union requirements (e.g. Salary, overtime payments, bonuses)							
Strikes							
Uncontrolled forces which may affect the service process (e.g. Terrorism, mafia and other criminal activities, etc).							
Unforeseeable events ("Acts of God": e.g. Storm, earth quake, flood)							
Resources cost variation (e.g. Material cost, energy cost, labor cost)							
Other suggestions							

Part 3: Questions for guided informal interview

1	Please describe the main products/ services your organization buy or sell.
2	Please mention your main customers/ suppliers of services.

3	Please describe the most common types of services you buy or sell for the operation of an O&G production facility.
4	Please describe the service strategy you use in your organization.
5	Please describe the cost drivers with respect to a service strategy.
6	Please describe the performance killers with respect to a service strategy.
7	Please describe the critical success factors with respect to a service strategy.
8	Please describe how the cost drivers, performance killers, and critical success factors vary for various phase of the service life of an O&G production asset.
9	Please describe performance measurement system and key performance indicators being used.
10	Please describe the changes you visualize in next 5-15 years in service strategy • with respect to changes in production profile • with respect to changes in technology (e.g. remote operation, remote condition monitoring, etc.)

Comments about the questionnaire:

THANK YOU for participating in the survey

Appendix IV
Service strategy implementation and execution

Implementation & execution of service strategy

Mapping service implementation/ execution process

Introduction

This survey is conducted as part of an ongoing research study at the University of Stavanger focusing on improving effectiveness and efficiency of operation and maintenance strategies for oil and gas (O&G) production installations. We especially focus on external and internal services needed to support (or perform) operation and maintenance activities. In the North Sea the oil and gas industry are gradually stepping into a new stage of development, as many O&G fields are reaching a mature stage (tail-end phase). At this stage operators seek to improve recovery and prolong the field life at lowest cost without compromising with HSE. At the same time production equipment and machinery will be reaching the last phase of their life cycle with increasing failure rate. Therefore, the challenge will be to achieve production goals, reduce OPEX and prolong the service life of the field, whilst improving the maintenance and safety. Operators' ambitions are to reduce the OPEX to an acceptable level by applying new technology and new organizational structures (DNV report, 2003). To reduce the OPEX one need to develop effective and efficient service strategies considering all influencing factors. Thereafter, the service strategy needs to be implemented and executed correctly and in effective way to create maximum value. To do that, need to be developed an execution model, which can cover requirements of all involved parties to avoid gaps, achieve customers' satisfaction and create a win-win situation. However, a well-developed service strategy does not automatically mean well executed.

If we take an example of a gap model as shown in Figure 1. In the Figure the broken line box shows the original gap model (Zeithaml and Bitners, 2000). The modified model presented here adds to the original model by including the assessment of any difference between required and delivered product support and services. In the model major causes for gaps in service delivery can be attributed to a) not

dimensioning the service correctly as per customer requirements and b) not integrating customer requirements into the service delivery strategy.

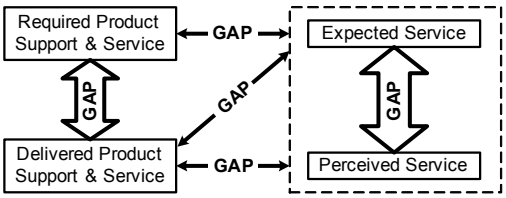

Figure 1 Modified product support and service GAP model

Purpose and goal

The main purpose of the survey is to map the service implementation and execution process, and to suggest a framework for development of a service strategy and execution. In earlier case study we mapped service strategy influencing factors and factors that build up influencing factors. We saw that a service strategy is influenced by a broad range of factors that are important and needs to be considered in operating a platform.

In this case study the focus will be on the implementation and execution of the developed service strategy (i.e. follow-up of the contract). We will compare contracts and their implementation and the execution process. In addition we will do guided interviews with personnel from different companies and analyze the collected data from interviews. This will form the basis for suggestions and recommendations

Service: Services are deeds, processes, and performance. Deeds are activities designed to solve problems which customers cannot solve them selves. Processes are identified approaches used to carry out deeds. Performance relates to how well a deed is performed, effectiveness and efficiency of quality (Zeithaml & Bitner, 2000)

Service Strategy: A service strategy is a plan for achieving the service goals of both the service receiver (buyer) and the service provider (seller). The plan states what services are needed (i.e. the service content and outcome), where they are needed (the location), how they are to be delivered (the service delivery process), when they are to be delivered and for how long time they are needed (timing and duration), to whom to deliver them and what resources are needed (personnel, skills, tools, equipment, etc.), and why the services are needed (the reason). The plan should also suggest approaches to fulfilling the defined service requirements to achieve the service goals, and define how to measure or evaluate the service performance.

Service Delivery Strategy (SDS): A generic plan for achieving the service delivery goals. This defines what is to be achieved in terms of services, what is to be delivered, how to deliver them based on considerations of product characteristics, operating environment, operational requirements, customer characteristics and preferences, geographical location, etc. The plan should as well define how to measure the service delivery performance. The plan should have a general section for all customers and a specific section for customers with special needs (Markeset, 2003).

Service Reception Strategy (SRS): A generic plan for achieving the service reception goals. The SRS is developed by customers/ service receiver and defines how to receive the services provided by service supplier so as to maximize the value added. The plan should as well define how to measure the service reception performance. The plan should have a general section for all suppliers and a specific section for products with special needs (Markeset, 2003)

Success factor: An influence factor which is decisive for success of an activity (e.g. competence and skills, marketing, input resource quality, sales and distribution channel, planning, etc.).

Cost driver: A major part of an activity, which dominate the total costs of the activity (e.g. high energy requirements, expensive distribution or intermediary, poor material quality, poor storage, etc.).

Performance killer: A part of an activity that influences processes in negative way even though they are not visible or strong (e.g. a process/ activity bottleneck, poor competence and skill, poor quality input material, poor tools, not well negotiated contract, etc).

Outsourcing: Outsourcing is a term to describe the transfer or contract out of an internal activity/ process/ product to an external supplier.

Insourcing: Insourcing is a term to describe the process of using external experts to perform internal activities in a company.

References:

1. Markeset, T. (2003). "*Dimensioning of product support: Issues, Challenges and Opportunities*", PhD Thesis no 6, Stavanger University College)
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Preliminary information

Name:

Position in company:

Job specification:

Working in current position since:

Working experience (years):

Name of the organization:

Part of a group (parent or subsidiary):

Type of organization (i.e., the primary and secondary purpose of your company):

Date:

Place:

Contact information:

Tel:
.

Fax:

E-mail:

Type of contract:

Time period of existing contract:

Note
Can we mention your company name in the report?
Yes: ☐ No: ☐

Questions for guided informal interview

1	Please describe the most common types of services needed for the operation of an O&G production facility.
2	Please describe the common reasons and needs for a contract.
3	Please describe the services and responsibilities of the involved parties. (e.g. who does what?)
4	Please describe the groundwork for the contract (e.g. special needs and requirements for the contract).
5	Please describe the involvement and the roles of different personnel in • Contract preparation • Contract follow-up
6	Please describe the contract execution model to implement and the development process of the model.
7	Please describe the factors, which have influence on a contract as well as on the implementation of the contract (e.g. working environment, management policy, culture etc.).
8	Please describe the tools and methodology being used to follow-up the contract.
9	Please describe most essential criteria for executing a service strategy to achieve reciprocal relationship satisfaction (please mention some of them).
10	Please describe the cost drivers with respect to a service execution process.
11	Please describe the performance killers with respect to a service execution process.
12	Please describe the critical success factors with respect to a service execution process.
13	Please describe how the cost drivers, performance killers, and critical success factors vary in various life of the contract implementation.
14	Please describe performance measurement systems being used in your organization with respect to services.
15	Please describe key performance indicators of the contract.

16	Please describe the changes you visualize in coming years in services and their implementation/ execution processes with respect to • ICT (Information Communication Technology (e.g. remote operation, remote condition monitoring, etc.) • Innovations and advancements of technology (e.g. development of maintenance free equipments/ systems, uses of more reliable, expert systems, etc.). • Innovations and advancements of services (e.g. total care solution, partnership, co-sourcing, outsourcing, insourcing, etc.) • What are the other major drivers (Please mention some of them)

Comments about the questionnaire:

THANK YOU for participating in the survey

Rajesh Kumar, PhD Student
University of Stavanger
Center for Maintenance and Asset Management
N-4036 Stavanger, Norway
Tel: +47 5183 2169
rajesh.kumar@uis.no

Tore Markeset, PhD
Associate Professor of Operations and Maintenance Management
University of Stavanger
Center for Maintenance and Asset Management
N-4036 Stavanger, Norway
Tel: +47 5183 2191
tore.markeset@uis.no

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