KUMAR, U. Service delivery strategy for mining systems. *Application of Computers and Operations Research in the Minerals Industries,* South African Institute of Mining and Metallurgy, 2003.

Service delivery strategy for mining systems

U. KUMAR
Department of Civil and Mining Engineering, Luleå, University, of Technology, Luleå, Sweden

Product designed characteristics like reliability and maintainability affect maintenance cost, service performance, and therefore product support strategy must be defined during design stage in terms of these two dimensions. Furthermore product support and service delivery strategy has considerable influence on the total life cycle cost and the economic viability of industrial systems/products.

The paper presents a concept for the development of service delivery strategy for industrial products with a special reference to mining systems. In this paper we emphasize that the strategy for product support should not be centred only on 'product' but it should also take into account the service delivery capability of the manufacturers/suppliers and users service organization, users competence and capability, product use location, logistics and infrastructures, etc., to arrive at the best performance and economic results. Such strategy should invariably include services supporting the client apart from considering services supporting the product.

The discussion in the paper is based on the experiences from the manufacturing industry engaged in manufacturing of mining systems and the observed trends in technology and management of operation and maintenance of mining systems.

Keywords: Maintenance and product support, Service supporting client, Service delivery strategy, Products reliability and maintainability, Product use location, Operating environment, etc.

Introduction and background

Modern day mining industry has become less physical and more cognitive as manual labour is gradually being replaced by machine operation. Such machines are expected to perform round the clock. However, due to design problems these systems are not able to meet customers' requirement in terms of system performance and effectiveness. This is often due to poor designed reliability and maintainability characteristics combined with poor maintenance and product support strategy, which often lead to unscheduled stoppages (failures). This has given a new dimension to the problem of effective and efficient management of maintenance and service processes. For many companies with high degree of mechanization, the maintenance spending accounts for a significant part of the operating budget but 'service and maintenance areas, is still considered as a minor element of strategic thinking within the mining industry. To avoid the complexities of maintenance management, many customers/users prefer to purchase only the required FUNCTION not the machines or systems so that the responsibility of maintenance and product support lies with organization delivering the required function. With advent of this trend, focus has shifted to the design of functional products. The definition of functional product is that the user is not buying a machine/system but the function it delivers. Figure 1 illustrates the definition of functional product and depicts the relationship between product (hardware and software) characteristics, type of application, and product support. For detail see Kumar, 2001 and Markeset and Kumar 2002. The continuous and broken lines indicate primary and secondary relationships respectively. Often designers and manufacturers develop systems and sell them to users (the continuous line). This is also called Technological push...i.e. one develops system and creates need for it. However, system should be developed keeping in view the application type-technological pull (this is depicted in the Figure 1 by the broken lines as often this is not the dominating reason for system development. Designed product characteristics define the types of application the product can be subjected to and the type of product support needed to achieve the expected function and performance.

Product support and service is mainly intended to maintain the reliability of product and for retaining the system in operating state or restoring them in operating state at the lowest cost. 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 and is also commonly referred to as after-sales service, customer support, technical support, or plainly as service (Goffin, 2000). Product support as a result of maintenance needs can be divided into tangible and intangible, planned (proactive) and unplanned (reactive). Product support is tangible if there is exchange of physical parts (e.g. spare parts, tools, documentation, training manuals, etc.) involved. If the service rendered only involves intangible support (e.g. expert advice, on-line support, etc) are often classified as intangible.

Product support or after-sales service, is important for manufacturers because it:

- can be major source of revenue
- is essential for achieving customer satisfaction

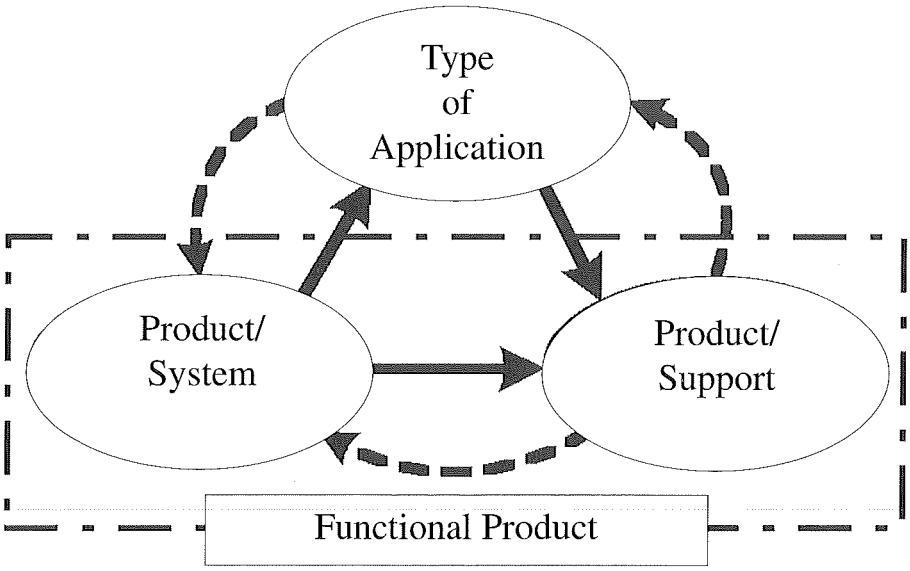

Figure 1. Functional product

- can provide a competitive advantage
- play a role in increasing the success rate of new products.

Successful service providers are the one who are able to *zero* the gap between the required services and the services delivered. However, in real life it is not that easy to define 'required services' as often it is influenced by the subjective criteria. Usually, customers have different expectations regarding services than the one defined by the functional need of the systems, and therefore service provider has to be intelligent enough to integrate customer's requirements and expectations into service delivery strategies. Figure 2 illustrates an extended service GAP model based on Zeithaml and Bitner (2000). Zeithaml and Biter's gap model is illustrated by broken line in Figure 2. The major causes for GAP in service delivery can be attributed to (a) not dimensioning the service correctly as per requirement, and (b) not integrating customer requirement into service delivery strategy. These GAPS are also due to suppliers, focus on delivering services to support the product but not delivering services to support the client (Mathieu, 2001). Furthermore, not matching performance to promise can also lead to customers' dissatisfaction with the services delivered. Quality of service delivery processes in relation to customer perceived satisfaction has been studied in depth by many researchers (see for example Grönroos, 2000, Berry *et al.* 1988).

Our recent study (see Kumar and Kumar, 2002) shows that many of the supplier/manufacturer of mining systems and equipment do not show any well-defined product support and service delivery strategies with exceptions of a few multinational companies. With its strong network of dealers, Caterpillar, a manufacturer of mining equipment designs better products and provides superior customer service. They have a strategy to adopt their equipment dealers as business partners for providing services (see Fites, 1996 for details). As a result, product support and service delivery remain under utilized assets. If a right strategy is adopted, benefits could create additional 'value' for both the manufacturer and system users and the mining sector as a whole.

Development of service delivery strategy

To reduce the gap in service delivered and services required by the system, and the expected services and the perceived services, provider of services have to adopt a strategy that should minimize these GAPS (Figure 2). Product design and service delivery both affect service performance, and therefore product support strategy must be defined during design stage in terms of these two dimensions to ensure the delivery of 'promised' product performance. Furthermore, product support strategy should not only be focused around product or its operating characteristics but also assist the customers with services that enhance product use and add additional values in their business processes.

In this paper we will present some of the factors that influence service delivery strategy and suggest approaches for service delivery strategy building to reduce these gaps, which will help achieving customers satisfaction and fulfill operational commitments. Our discussion in this paper is focused on mining systems in a multinational environment and is based on research work reported in Kumar and Kumar (2002).

Before developing any strategy, service provider should answer these questions.

- What is functional requirement?
- What is the service requirement of system?
- What customer wants?
- Where is the service delivery point located?
- What is it to be done?
- What is the customers organizational behaviour and culture

The answers to these questions lead us to a strategy where service delivery strategy is not only product centred but also include the service supporting the clients. Figure 3 illustrates a general framework for service delivery strategy and management.

Service and maintenance need of products

Product support and service needs are dependent upon product characteristics such as reliability and maintainability, the customer's abilities and capabilities,

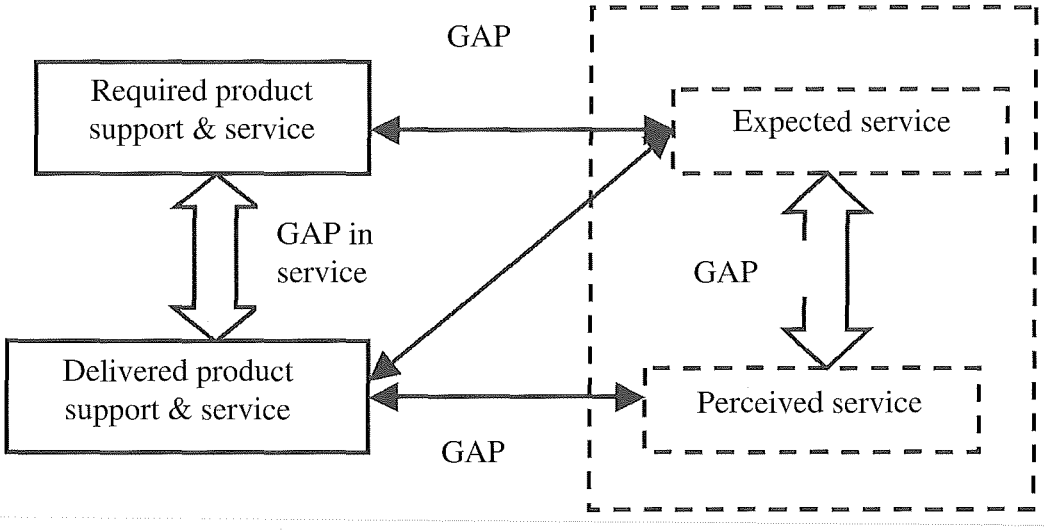

Figure 2. Extended product support and service GAP model

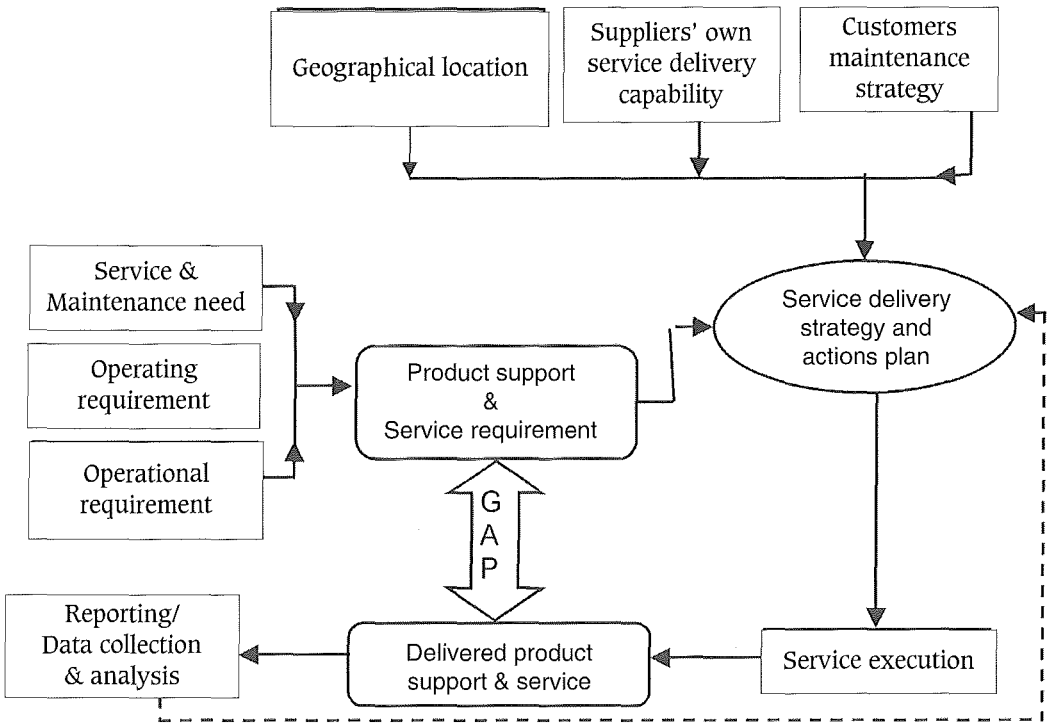

Figure 3. A general framework for development of service delivery strategy and management

and the environment the product is going to be used in. Therefore, product support specifications should be based on product design specifications and they should be agreed upon early on in the design phase (Moss, 1985). The idea is to be proactive in the design phase, not reactive in the exploitation phase. It is evident that product characteristics like reliability and maintainability have major influence on the maintenance and service need of the system (see Markeset and Kumar, 2001). Therefore, before finalizing product support strategy one must get knowledge about R&M characteristics, which in turn define the maintenance need of the system. There exists a large volume of literature that deals with these issues and will not be covered here (see for example, Dhillon, 1999). Besides reliability and maintainability characteristics, the operating environment has also considerable influence on the product support requirement. System engineering approach is an effective approach to incorporate functional requirements and customer's specifications into the design process. It is a top-down approach to product development, viewing the system as a whole, focusing on customer's needs, wants, preferences, and requirements, starting with the functional requirements and the functional performance of the product (Blanchard, 1998).

Operating environment

The need for product support and service is highly environment sensitive. This need will depend on local factors such as climate and use condition The

environmental conditions in which the equipment is to be operated, such as temperature, humidity, dust, road conditions, maintenance facilities, operator training, etc., often have considerable influence on the product reliability characteristics and therefore on the maintenance need of the systems. For detail discussion on this see Kumar and Kumar, 1992, Kumar *et al.* 1992. Thus operating environment should be considered seriously while dimensioning product support and service delivery performance strategies since it will have an impact on operational and maintenance cost and service quality. Apart from operating environment, geographical location of application site is an important factor that should be considered in development of service delivery strategy.

Geographical location

The geographical location of the site of product application has considerable influence on the service delivery strategy. If the service provider is located close to the user, it may take a shorter time to get hold of spare parts and assistance, while if the product user is located far away from the manufacturer service delivery system, becomes very critical. All these issues need to be considered in the early design phase of the product by the manufacturer, customer, and distributors/supplier in unison.

Furthermore, service delivery is affected by the geographical distribution, geopolitical situation and customers demand for prompt response. Consequently, many firms develop a dispersed network of service facilities that warehouse spare parts, provide a base for field service representatives, and provide information and training. Managing service delivery networks thus requires a diverse collection of human and capital resources. Careful attention must be given in particular, to both the *design* and *control* of the service delivery system: each facility's location, capacity, staffing, scheduling, capabilities and management of material flow apart from the product designed characteristics (Ghodrati and Kumar, 2002).

Facility location is the process of determining a geographic site for a firm's service outlets. Managers of both service and design departments must weigh many factors when assessing the desirability of a particular site, including proximity to customers and suppliers, labour costs, and transportation costs. Managers can divide location factor into dominant and secondary factors. Dominant factors are those derived from competitive priorities (cost, quality, time, and flexibility) and have a particularly strong impact on sales or costs. Dominant factor in service briefly are: proximity to customers, transportation costs and proximity to markets, and location of competitors. Secondary factors also are important, but management may downplay or even ignore some of them if other factors are more important.

However, geographical locations are becoming interestingly irrelevant in location decisions, owing to improved communication technologies such as e-mail, faxes, video conferencing, and overnight delivery. An important exception is manufacturing firms that utilize just-in-time system, which rely on supplier proximity.

Manufacturers/suppliers service organization

In general, manufacturers/suppliers beside being a manufacturer also need to maintain a service organization delivering services to their customers in the same way as any other service organization such as a hotel, travel agency, police, school, etc. Therefore, most of the manufacturers usually have a service department responsible for delivering services such as assistance in fault finding, failure diagnostics, supplying expert assistance, spare part delivery, spare part storage, etc. However, many manufacturing companies are uncomfortable with intense service expectations of today's industries. The service department usually function in a different way than other internal departments since its relationship with the customers often is of a much longer duration. The service department needs to stay in contact with the companies for the rest of the product life span. While designing for product support, designers have to analyse its own service delivery capability and the maintenance and service organization at the users end. This will help the designer to design the right support. As mentioned in the preceding section, this necessitates that manufacturing companies should analyse and understand its 'customer' before adopting any strategy for service delivery. If not, outcome can be poor product support and a dissatisfied customer. In such situations, often it is advantageous to make local dealers partners in service delivery, as they understand both the culture and customs of the customers apart from understanding the functional requirement.

Product user's/owner's maintenance organization and maintenance strategy

While designing and dimensioning of a product support and service delivery strategy, it is important to analyse owners', or operators', maintenance organization and level of competence, etc., to arrive at the best service and maintenance delivery strategy. It is of utmost important that service delivery strategy must match to that of customers' maintenance and service strategy and more specifically *Service Reception* strategy.

Because different cultures hold different views, a managerial style that is effective in one culture will not necessarily be effective in another. Therefore, to be effective in cross-cultural management, managers need to understand the nature of the culture of the country where they are going to be managing, and how to adapt their managerial style accordingly.

Local or multinational environment

Firms usually make strategies as per location of the customers. Markets can be divided into national market and international market. It's easier for service provider to operate in national market because they know about the culture, government rules and regulations, geographical conditions, etc. Therefore, it is easier to establish contact with customers and deliver them the required services. But in international market, service delivery provider has to make investment to learn about the customers' cultures, corporate rules and regulations. Global market's customers can be divided into two categories considering standard of living, namely customers from developed countries and from developing countries. Often the approach adopted for service delivery has to integrate the local conditions in their strategy otherwise service delivery strategy will not be economically viable and runs the risk of failure. Often customer expectations are high in developed countries, lower tolerance, and so require continuous improvement in service quality. Customers in developing countries have lower quality of expectations so wider zone of tolerance for

ineffective services compared with customers in developed countries (Malhotra *et al.* 1994) but marketing of services needs emphasis on personal contact and understanding of local culture in case of developing countries. In developed countries more or less same approaches can be adopted as far as marketing of services are concerned.

Service performance measurement

The main purpose of performance measurement is to see whether system and organizations are performing, as they should. This helps in taking decision concerning resource allocation and subsequent control of outcomes. Such measures can be customer satisfaction index or return on investment or increased demand of companies' product, etc. Some other measures are the number of backlog in customers' service orders, etc. One way is to compare the outcomes measures with performance targets, etc., or benchmark the performance with competitors (see Figure 3).

Conclusions

Customer satisfaction is dependent not only on how well the product performs its function, or how reliable the product is, but also on how reliable, flexible, courteous, and so on, the support and service the customer experiences. In a long-term perspective, a manufacturer will benefit from supplying a product that needs as little maintenance as possible. However, if it is not possible to design out the maintenance, one has to design the product for maintenance and product support. Customers are also evaluating service quality according to reliability, access, and understanding of the customer, responsiveness, competence, courtesy, communication, credibility, security, and tangible considerations.

In this paper we emphasize that the strategy for product support should not be centred only on 'product' but it should also take into account the service delivery capability of the manufacturers and users service organization, users competence and capability, product use location, logistics and infrastructures, etc., to arrive at optimal decisions. Such strategy should develop services that support the clients.

The paper has provided a general framework for development of service delivery strategy by taking into into account product design characteristics, information technology applications, capability of service delivery organizations, client's service needs and expectations, and manufacturer's delivery capabilities, etc.

Acknowledgements

Author is thankful to Graduate students, Behzad Ghodrati, Rajesh Kumar and Tore Markeset for their help and assistance in preparation of this manuscript.

References

BERRY, L.L., PARASURAMAN, A., and ZEITHAML, V.A. The Service-Quality Puzzle", *Business Horizons*, September-October, vol. 31, 1988, pp. 35–43.

BLANCHARD, B.S. *Systems Engineering Management*, 2nd ed. New York: Wiley, 1998.

DHILLON, B.S. *Engineering Maintainability: How to Design for Reliability and Easy Maintenance*, Houston, TX: Gulf, 1999.

FITES, D.V. Make your Dealers your Partners, *Harvard Business Review*, March-April, 1996, pp. 40–51.

GHODRATI, B. and KUMAR, U. 'Integration of product designed characteristics in dimensioning of Product support for effective supply chain management, Research Report , Luleå University (In preparation) 2002.

GOFFIN, K. Design for Supportability: Essential Component of New Product Development, *Research-Technology Management*, vol. 43, no. 2, March-April, 2000, pp. 40–47.

GRÖNROOS, C. *Service Management and Marketing: A Customer Relationship Management Approach*, 2nd ed. Chichester: Wiley, 2000.

KUMAR, D., KLEFSJÖ, B., and KUMAR, U. Reliability Analysis of Power Cables of Electric Loader using Proportional Hazard Model', *Reliability Engineering and System Safety*, vol. 37, 1992, pp. 217–222.

KUMAR, D. and KUMAR, U. Proportional Hazard Model: A useful Tool For the Analysis of a Mining System, In *Proceedings of the 22nd APCOM Symposium*, Tucson, Arizona, USA, April 6–9, 1992, pp. 717–724.

KUMAR R. and KUMAR U. Service delivery strategy for industrial products in a multinational environment", Research Report, Luleå University, (In preparation), 2002.

KUMAR, U. Design and Development of Service and Maintenance Concepts for Mechanized and Automatic Mining Systems, APCOM 2001: Keynote Lecture: In *Proceedings of the 4th Regional Symposium on Computer Applications in the Mineral Industries*, Tampere, Finland, September 3–5, 2001 pp. 11–22.

MALHOTRA, N.K , ULGADO, F.M., AGARWAL, J., and BAALBAKI, I.B. A Comparative Evaluation of the Dimensions of Service Quality between Developed and Developing Countries, *International Marketing Review*' vol. 11, no. 2, 1994, pp. 5–15.

MARKESET, T. and KUMAR, U. R&M and Risk Analysis Tools in Product Design to Reduce Life-cycle Cost and Improve Product Attractiveness, In *Proceedings of The Annual Reliability and Maintainability Symposium*, Jan 22-25, Philadelphia, USA: 2001, pp. 116–122.

MARKESET, T. and KUMAR, U. Integration of RAMS and Risk Analysis in Product Design & Development Work Processes, In *Proceedings of the International Foundation for Research in Maintenance Conference* 2002, Maintenance, Management & Modelling Conference, May 6–8, Växjö, Sweden, Paper no. 16., 2002.

MATHIEU, V. Product Services: From a Service Supporting the Product to a Service Supporting the Client, *Journal of Business & Industrial Marketing*, vol. 16, no. 1, 2001, pp. 39–58.

MOSS, M.A. *Designing for Minimal Maintenance Expense*, New York: Marcel Dekker Inc.,1985.

ZEITHAML V.A. and BITNER, M J. *Service Marketing*. 2nd ed., Irwin, U.S.A, 2000.