IN SEARCH OF A VIABLE SYSTEM MODEL FOR AFTER-SALES SPARE PARTS SERVICE IN TELECOM FIRMS

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ABSTRACT

After-sales spare part service is a competitive differentiator and a source of profit enhancement in OEM (Original Equipment Manufacturer) telecom firms. By seeking greater differentiation, more loyal customers, and higher margins and profits, the OEM needs to develop a more effective service-to-profit supply chains. But, predicting service requirements, inventory needs, supply chain parameters, etc. is extremely challenging. In order to tackle and mitigate this kind of problems and to have a more holistic approach of the system, this paper shows how to build the structure of the after-sales service supply chain going from strategic to operational issues using a Viable System Model (VSM) approach.

Keywords: Viable System Model, after-sales spare parts service, telecom industry.

INTRODUCTION

The service industry plays an important role into the economic activity in any society. Fitzsimmons and Fitzsimmons (2007) stated that during the past 90 years, we have witnessed a major evolution in our society from being predominantly manufacturing-based to being predominantly service-based. Nowadays the last constitutes the new engine for global economic growth. The service sector encompassed “all economic activities whose output is not a physical product or construction, is generally consumed at the time it is produced, and provides add value in forms (such as convenience, amusement, timeliness, comfort or health) that are essentially intangible concerns of its first purchaser" (Quinn, Baruch & Paquette,1987). Into the telecom industry: repair, spare parts, installing upgrades, technical support, consulting, training, field corrective maintenance, etc., are typical after-sales services offered by the Original Equipment Manufacturer (OEM). By offering services, the operating margin contributions outweigh the benefits of increased revenue as much as 50% if the service is efficiently manage by the OEM, although most companies either do not know or do not care to provide after sales service effectively (Cohen, Agrawal & Agrawal, 2006a).

Today, operator customers are pursuing to outsource services for a number of reasons. Of particular interest among them are: reduce capital expenditures (CAPEX) and operational expenditures (OPEX) in inventory investment and management respectively, cash flow improvements, reduced operational complexity, network availability improvements, etc. According with the consulting firm Pyramid Research (2006), 47% of the mobile operators, outsource some or all of their spare parts management activities while wireline operators just 21%. In 2007 Pyramid Research conducted a research on global and regional mobile operator's spends on services. The category “spare part management, repair and replacement" shows a global increase trend for the next years in outsourcing, going from a spend of $3904 US million in 2005 up to $5616 US million in 2010.

These last numbers represent a growing opportunity of revenue streams and profit for OEMs, but capture this profit is not easy and the OEM after-sales service parts need to face different challenges, e.g. customer needs and behavior, logistic management, budget limit, IT infrastructure, product upgrades, phase-out products support, product quality, warranties, worldwide repair vendor network, import/export processes, customer support, customer network installed base visibility, long supply and repair lead times, intermittent and probabilistic demand, integration and coordination between different echelons within the supply chain, variability across the entire supply chain, etc.

In the realm of service parts management, relationships between OEMs and operators are often established through service agreements that extend over a period of time. The details of these service agreements vary in nature depending on customer requirements, e.g. response time, customer budget, etc. Then customer concern would be high network availability and OEM challenge would be to allocate and optimize resource to commit the agreement.

The design and model of the after-sales service parts supply chain cannot comes from the manufacturing models as stated by Cohen, Agrawl and Agrawl (2006b), e.g. demand is predictable in manufacturing and the opposite in after-sales services, the response time can be schedule in manufacturing and as soon as possible (same day or next day) in after-sales services, the product portfolio is homogeneous in manufacturing versus always heterogeneous in after-sales services, etc.

In meeting these challenges, certain authors have addressed this kind of problems. From a mathematical perspective the books of Sherbrooke (2004) and Muckstadt (2005) encompass the more relevant advances to model the system. From a business side, Ray (2004), Cohen, Agrawal and Agrawal (2006a; 2006b), discuss and suggest methodologies to properly manage the service supply chain.

The objective of this paper is to show a systemic approach to support the after-sale spare part service using the Viable System Model (VSM) methodology, involving strategy, tactical and operational aspects into an integrated manner that helps the after-sales service organization to design and operate the supply chain. Section 2 describes the process concerning the spare parts service, section 3 describes the VSM methodology, section 4 integrates the spare parts service using the VSM, and finally some conclusion remarks.

SPARE PARTS SERVICE

OEM telecom firms offer different after-sales services portfolio to their customers, e.g. technical support, return for repair (RfR), advance & exchange (AE) spare parts, field corrective maintenance, etc. As stated before, OEMs and operators established the service scope through an agreement. This must clearly defined and integrated the service with tools and processes that define the technical aspects of service delivery as well as the metrics that quantify the effectiveness of the service (Hartley, 2005). Also, this must identified the product hierarchy that is going to be support by geographic region (Cohen, Agrawal and Agrawal, 2006b). The Service Level Agreement (SLA) must be attainable, affordable, measurable and must focus on the customer's primary business (Trindade & Nathan, 2005). Once negotiated, operators concern must be network availability through the SLAs, and OEMs must focus on achievable SLAs that distinguish their services from competitors.

This paper will focus only on RfR and AE services which are both related with spares. In a RfR service, the operator send a faulty part to the OEM, then the commitment is to return a good part to the operator in a contractual specified time, e.g. 30, 60 or 90 days. Depending on the repair cycle time and the contractual time, the OEM needs to balance the differences between these two times through the use of a spare pool, e.g. if 30 days is contractually established and the repair cycle time is 90 days, then the OEM will need to allocate a spare pool to meet customer agreement. The repair system faces different challenges: thousands of items management, worldwide repair vendor network, operator cumulated demand, different import/export country requirements, material handling damage risk, etc.

Regarding the AE spare parts service, consider a two-echelon distribution/repairable system as shown in figure 1. The process is as follow: the customer requests part(s) to the OEM's call center. Then this captured the required information to properly make the delivery. The delivery might be according with the SLA, e.g. 2 hr, 4 hr, Next Business Day, etc., from an specified local warehouse () . In parallel to the delivery process, the central warehouse (DC0) replenishes the local warehouse to keep a specified inventory level. Once the customer receives from the OEM the good part, he returns a defective unit back to the OEM in an agreed (in practice it is random) number of days. Then the defective part is send to repair (RC) and once repaired, the part is allocated in the pool of good units into the distribution center. When units are not repairable, these can be sent to scrap. Also when the OEM has excess inventory, this can go to the scrap process. The time elapsed since the delivery of the good unit from the OEM to the operator until the units are repaired and returned back to the inventory will be called the Turn Around Time (TAT). This includes the defective collect time and the repair cycle time.

It is very important to mention that the customer-echelon has an important role into the supply chain performance due to the service/supply process variability introduced by the customer. Basically there are two types of variability: (i) the first is related with the demand/failure parts process which includes the activities that use and thus subtract material from the warehouse inventory, (ii) the second is linked with the defective collect process, where the customer is an active participant into the TAT formula. In order to tackle the first variability, OEM uses operator installed base database and part failure rate(Trindade & Nathan, 2005; Meeker,1998) to predict demand; the second variability reduction depends on OEM-operator's effort to return the defective units back, and it's up to them how much effort they apply to the task (see Frei (2006), who outlined strategies for managing this variability).

THE VIABLE SYSTEM MODEL

Human organizations are much more complex than we are usually prepared to admit. Organization charts do not show how the organization really works, and in fact, real-world systems have variety which is effectively mathematically infinite. Consider the system model in fig. 2. The Operation is the element which does things.

The Management is the element which controls the doers. And the Environment is the surroundings in which they function. The variety in the surrounding Environment will always be greater than that in the Operation, which in turn will be greater than that in the Management of the Operation. In order to cope with its environment, the Operation needs to match its variety to that of the Environment. In order to manage the Operation, Management needs to match its variety to that of the Operation. The Operation can cope with its Environment, as long as it can successfully absorb the variety from it, by attenuating the incoming variety, and amplifying its own variety back to it. Likewise, Management can cope with the Operation as long as it can successfully absorb the variety from it, by attenuating the incoming variety, and amplifying its own variety back to it. Here it is very important to take into account the Ashby's Law of Requisite Variety, which stated that control can be obtained only if the variety of the controller is at least as great as the variety of the situation to be controlled (Ashby, 1957). If these requirements are met, the system can maintain itself in a state of equilibrium, which is called self-organized system. If these requirements are not met, the system will become unstable and eventually leading to its collapse.

What persists in self-organized systems is the relationship between the components, not the components themselves. They have the ability to continuously re-create themselves, while being recognizably the same. This ability to maintain identity is related to the fact that these systems have purposes. These purposes provide the framework for their maintenance of identity.

The Viable System Model (VSM) claims to reveal the underlying structures necessary for a system to meet the criterion of viability. The VSM methodology was developed by the cybernetician Stafford Beer (Beer, 1972). The criteria of viability require that organizations are or become ultra stable, i.e. capable of adapting appropriately to their chosen environment, or adapting their environment to suit themselves. The VSM models the structures of the organization and the relationships between them. This includes key processes, communications, and information flows. The model is composed of five interacting subsystems. Kinloch *et al* (2009) states in summary, that systems 1-3 are concerned with the “here and now" of the organization's operation, system 4 is concerned with the “there and then" - strategical responses to the effect of external, environmental and future demands of the organization and system 5 is concerned with balancing the “here and now" and the “there and then" to give policies directives which keep the organization as a viable entity.

System 1 refers to the fundamental operations within a viable system which enclosed several primary activities. Each primary activity is itself a VSM.

System 2 consists of a regulatory center for each element of system 1 and allows system 3 to monitor and coordinate the activities of system 1.

System 3 is responsible for system 1 control and provides an interface with Systems 4/5.

System 4 has the purpose to look outwards to the environment to monitor how the organization needs to adapt to remain viable and need a feed back through system 3.

System 5 is responsible for policy decisions. The former role effectively defines the identity and ethos of the organization - its personality and purpose.

In addition to the subsystems, there are some principles to make the system viable:

- Managerial, operational and environmental varieties diffusing through an institutional system, tend to equate; they should be designed to do so with minimum damage to people and cost.
- The four directional channels carrying information between the management unit, the operation, and the environment must each have a higher capacity to transmit a given amount of information relevant to variety selection in a given time than the originating subsystem has to generate it in that time.
- Wherever the information carried on a channel capable of distinguishing a given variety crosses a boundary, it undergoes transduction; the variety of the transducer must be at least equivalent to the variety of the channel.
- The operation of the first three principles must be cyclically maintained through time without hiatus or lags.

INTEGRATING SPARE PARTS PLANNING WITH VSM

Organizations need a link between the strategy and operations. OEMs compete on services but they need to make a trade-off between them vs costs. This trade-off can be depict through and efficient frontier curve shown in figure 3. This represents the most efficient (lowest cost) system for achieving a given performance level. Points below these curves are infeasible and above inefficient. Taking into account this trade-off, this section will apply the VSM to the after-sales spare part organization in order to link the strategy with operations and to do the system viable.

System 1 - Operation

After-sales spare parts service operations were described in section 2. This system encompasses all the primary activities to provide the AE & RfR service. Figure 4 shows how the different entities are related each other. The OEM is the core operation center.

The connection between the Operator request and the OEM is through a Call Center with the help of a ticket system. If an AE service is required, then the Customer specifies the require part number, the delivery address, contact, phone number, etc., then the OEM must deliver the requested unit according with the SLA from the appropriate warehouse. The faulty unit is returned back accordingly with a contractual number of days. Once the OEM receives the faulty unit then this is send to repair with a specific ticket number. Another activities that take place in the operations are the replenishment, rebalance, redeployment, new buys and scrap inventory transfers. All these activities are registered into the ticket system and the Enterprise Resource Planning (ERP) system and have a cost associated.

RfR services are slightly different from AE services with less inventory investment and less service failure risk, but use the same elements shown in figure 4. The process begins with a repair ticket requested by the Operator. Then the OEM received the faulty unit and this is sending to repair. Once repaired the unit is returned as refurbished to the Operator under a specific SLA. All transactions are registered also in the ERP system.

System 2-Coordination

The supply chain shown in System 1 involves multiple levels and organizations. Coordinating the stocks and flows of inventory in such multilevel system is a central challenge. In order to be viable and into the efficient frontier curve (see figure 3), the Operations need to co-operate with each other, and maintain a suitable state of balance between them. As stated by Hopp (2008) the relevant insights which are related with the inventory coordination in the supply chain are: (i) bottlenecks cause congestions, (ii) variability degrades performance, (iii) variability is worst at high utilization resources, (iv) batching causes delay, and (v) pull is more efficient tan push. An interesting phenomenon that occurs in supply chains is the observed increased in demand as we travel up in the supply chain. This increase in variability is referred to as the bullwhip effect (Lee, Padmanabhan & Whang, 1997) and causes significant operational inefficiencies. Thus, it is important to identify strategies to efficiently coordinate the supply chain and cope with the bullwhip effect. The coordination among the Operator and the OEM as well as between the OEM and the Repair Vendor take place also through contracts which establish and align in some manner how the units will flow in the supply chain.

The structure of the hierarchical organization coordinates also the task of different individuals into the supply chain. Bar-Yam (2004) mentioned that today real organizations are not pure hierarchies. They are hybrids of hierarchies and networks. There are many lateral connections corresponding to people talking to each other and deciding what to do". Finally material flow into the supply chain in some degree is also data flow. This must be properly registered and coordinated into the ERP and Ticket system. Later the data needs to be converted into information in System 3.

System 3-Management and 3* Audit

System 3 is occupied basically on tactical tasks related with the after-sales spare part service. The principal concerns are customers, so the KPI metric review is in the top of different management tasks. Here, on-time delivery (OTD) is the typical metric used to measure the OEM performance. Important information to properly allocate and optimize resources is the entitlement database of each customer contract. This information is commonly used into the planning process and into the KPIs elaboration. Data analysis is also an important task to review around customer's behavior. This part of the process can be supported by a Customer Relationship Management (CRM) system.

In terms of material planning: demand analysis, TAT analysis, supply chain queue analysis, and stock optimization, are part of the analysis. This provides the basis for operations decisions in System 1 such as replenishment, rebalance, repair and defective collect priorities, new buys and scrap. All these analysis are managed by a Decision Support System (DSS).

In the supplier relationship management (SRM) system the goal is to streamline and make more effective the process between the OEM and the 3PL and the Repair Vendor. The financial management takes care of the inventory turnover metric, the gross and net inventory plan through the new buys and scrap process control and also the logistics and repair costs associated with all the customer contracts.

System 3* Audit allows System 3 Management to be in directly contact with operations. This provides a feedback loop which creates a continuous improvement environment.

Once System 3 received all the information and, based on System 4 guideline, it established the critical success factors (CSFs) which will ensure the success of the services.

System 4-Strategy

System 4 is strongly future focused and more involved in strategic management. Here the service portfolio must be elaborated and this should be associated with strategic resources and information, e.g. the warehouse network to commit the service, the repair vendor network, budget, human resources and organization definition, market research, strategic planning, IT, etc. System 4 translates System 5 Board of Directors instructions and, in the other way, translates System 3 information.

Another important role of System 4 is to be in contact with the environment. Then, System 4 is the point where internal and external information can be brought together. System 4 needs to determine where on the efficient frontier to locate (see figure 3). In order to analyze either external as well as internal data, System 4 uses different DSS or data mining tools to determine the trade-off into the efficient frontier curve.

System 5-Policy

System 5 supplies a logical closure of the system as a whole and defines the identity and ethos of the organization. The main roles of Policy are to provide clarity about the overall direction, values and purpose of the organizational unit; and to design, at the highest level, the conditions for organizational effectiveness. One of the key conditions for organizational effectiveness relates to how the Strategy and Management functions are organized and interconnected. According with Bar-Yam (2004) “the rule of thumb is that the complexity of the organization has to match the complexity of the environment at all scales in order to increase the likelihood of survival".

CONCLUSIONS

Although there are great developments in technology and business models, the integration of a global service parts supply chain is still challenging. The VSM emerged from the field of cybernetics which sought to design information processing and decision-making machinery using the structure of the nervous system as a guide. In this work we used this approach to model the after-sales spare part service system. The proposed approach shows how every element of the system is connect each other going from the strategic to the operational side. The use of the VSM provides also the ability to balance both internally and externally the after-sales spare part service system and making adaptable to changes. Other concepts from systems theory, systems dynamics, knowledge management, complex systems, etc. can also be analyzed in a future research to incorporate methodologies or concepts that help better understand the dynamics of the supply chain service part system; however, the proposed approach can be use as a guide for diagnosing.

REFERENCES

Ashby, W.R., (1957). *An introduction to cybernetics*, Chapman and Hall

Bar-Yam, Y. (2004). *Making Things Work*, *Solving complex problems in a complex world*, NECSI Knowledge Press.

Beer, S. (1972). *Brain of the firm*, The Penguin Press,

Cohen, M., Agrawal, N. and Agrawal, V. (2006a).Winning in the Aftermarket, *Harvard Business Review*, May:129-138.

Cohen, M. Agrawal, N. and Agrawal, V. (2006b). Achieving Breakthrough Service Delivery Through Dynamic Asset Deployment Strategies, *Interfaces,* 36(3):259-27.

Fitzsimmons, J.A. and Fitzsimmons, M.J., (2007). *Service Management,* McGraw-Hill.

Frei, F.X., (2006). Breaking the trade-off between efficiency and service, *Harvard Business Review*, November: 92-101.

Hartley, K.L. (2005). Defining Effective Service Level Agreements for Network Operation and Maintenance, *Bell Labs Technical Journal*, 9(4):139-143.

Hopp, W.J. (2008).*Supply Chain Science,* McGraw-Hill.

Kinloch, P., Francis, H., Francis, M. and Taylor, M., (2009). Supporting Crime Detection and Operational Planning with Soft Systems Methodology and Viable Systems Model, *Systems Research and Behavioral Science*, 26 (1): 3-14.

Lee, H.L., V. Padmanabhan and S. Whang, (1997). The Bullwhip Effect in Supply Chains, *Sloan Management Review*, 38(3): 93-102.

Meeker, W.Q. and Escobar, L.A. (1998). *Statistical Methods for Reliability Data*, Wiley Interscience.

Muckstadt, J.A. (2005). *Analysis and Algorithms for Service Parts Supply Chains*, Springer.

Pyramid Research (2006). Demystifying Operator Network Budgets, http://www.pyramidresearch.com/points.htm November, 2007.

Pyramid Research (2007). Global and Regional: Mobile Operator Spend on Services, http://www.pyramidresearch.com/points.htm November, 2007.

Quinn, J.B., Baruch, J.J. and Paquette, P.C. (1987). Technology in services, *Scientific American*, 257 (6):50-58.

Ray, R. (2004).Where the money is what it takes to do service parts planning right*,* *APICS The Performance Advantage*, 14, (10):42-48.

Sherbrook, C.C. (2004). Optimal *Inventory Modeling of Systems*, Multi-Echelon Techniques, Kluwer Academic Publishers, 2nd edition.

Simchi-Levi, D., Kaminsky, P. and Simchi-Levi, E. (2003). *Designing and Managing the Supply Chain, Concepts*, Strategies and Case Studies, 2nd edition, McGraw-Hill.

Trindade, D. and Nathan, S. (2005). Simple plots for monitoring the field reliability of repairable systems, *IEEE RAMS,* 539-544.