Outsourcing maintenance in services providers

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ABSTRACT: This paper presents a framework about management in maintenance outsourcing in a service provider company. It proposes key aspects for taking decisions in a well-established and controlled organization. Cost is not the most important aspect to consider in outsourcing, the decision has to be a global and strategic idea inside the company. Of course, not only the directors must take part, but also the technical personnel of maintenance. We are trying to offer a basic guide to establish an outsourcing service, with guidelines and possible evolution. It is based on a practical view of knowledge management over ten years of professional experience focused in networks. Below there is a case study which demonstrates a methodology for decision-making and shows how to optimize the organization without losing differing levels of knowledge. For this, we employ quantitative and qualitative criteria to obtain a wide consensus and acceptance.

1 INTRODUCTION

The outsourcing in maintenance is a practice being increasingly used (Elfing & Duening 1994), especially with services providers. Although the decision to outsource is not a simple decision, it is a strategic decision (Click & Duening 2005) for an organization, and as such, it should align itself with the business to impact positively on the objectives of the organization.

There are different strategic reasons for which people decide to execute processes of outsourcing. For example many managers who are making a process of outsourcing, believe that it is an assignment carried out of responsibility to manage a part of the business with the supplier. Other motives are primarily economic, issues which endanger the control of outsourcing.

Faced with this, it is advisable to continue the process guided by decision making-steps, to ensure the outcome of outsourcing is properly reached in maintenance. In this document we will attempt to provide a framework for guiding implantations of outsourcing in service providers companies.

For this, we have structured this document in five parts. In the first two paragraphs, points 2 and 3, we begin with a base revision on outsourcing and maintenance in suppliers of services. After, in point 4 we will develop the reference model that is proposed and finish with a case study and conclusion.

2 OUTSOURCING

Outsourcing is defined as the delegation of business functions totally or partially to another company along with part of the administrative and operational control. Therefore, it is established between two companies, a supplier and a customer, a contractual relationship governed by service agreements.

Mainly, with a process of outsourcing we are looking for the specialization in activities, not keys for the organization (Elfing & Duening 1994), such as systems, accounting, buildings, human resources, call centres, engineering, logistics, etc. For which, it can transfer resources which bore those functions formerly.

The decision of outsourcing is a strategic decision (Earl 1996), aimed at improving the objectives of the organization:

- Improving Quality
- Improving Security
- Reducing Cost
- Optimizing Resources

Therefore, the organization should focus its efforts in improving those functions that are a source of competitive advantages and more profitable to the core business.

Outsourcings have several advantages and disadvantages (Alexander & Young 1996, Halvey & Melby
2005, Jharkharia & Shankarb 2005, Tho 2005), and within the advantages we can list:

- Reduction costs, at the same quality to employ a supplier more specialized
- Restructuring costs, changing fixed costs by variable costs in terms of services provided
- Stimulates the local employment through contracts with local firms
- Obtaining rapid budget by selling assets
- Improvement of quality, for higher specialization
- Access to outside expert knowledge
- Standardization and access to scale economies
- Flushes resources for other purposes
- Improves company focus
- Improving management of difficult functions to handle
- Optimizing routine tasks
- Share the risk by flexibility of demand with the supplier company
- Provides legal guarantee for services
- Relationships developed between financial aspects and levels of service
- Starting point for changes in the organization
- Speed through reengineering

We also have to consider potential risks and disadvantages which affect any outsourcing plan:

- Unfulfilled or questionable expectations, for a scenario developed to generate the process of outsourcing.
- Changes in the quality for breach of agreements on services, either by the knowledge or capabilities of the supplier company, or by errors in the definition of the same company.
- Loss of knowledge or skills through transfer to the supplier, where it is more difficult to retain and improve, this happens frequently.
- Loss of control over the externalized functions, source of learning for the internal staff.
- Dependence by the supplier could cause adverse consequences for the client (investments extraordinary).
- Loss of security by transferred staff to the supplier, by hoax and illegal transmission of knowledge and information to the competence.
- Public and internal opinion for outsource jobs to another company.
- Loss of motivation for staff involved in the service, because it can create a feeling of alienation within the client company and result in the staff feeling their jobs are valueless.

Although, the decision about which activities are to be outsourced, it is often described as the beginning of the process, however, really the process should begin much earlier, defining the mechanisms to start from a stable situation where the organization is controlled, and avoid a difficult management of change.

The maintenance outsourcing could be an advantage as in other businesses, with the order to devote most of the internal efforts in the core processes, and seek the specialization of external agents. Although, it should be guided by three types of criteria: strategic, technical and economic.

Organizations often outsource those activities which have work patterns that are fluctuating in their burden and performance, and then the maintenance and especially within distribution networks that meet this requirement.

Below, we describe the nature of maintenance in companies of distribution services and consider them for the decision of outsourcing.

3 MAINTENANCE IN SERVICES PROVIDERS

Maintenance is characterized as a highly complex field inside business and involves various disciplines: management, human resources, company economy, security, and knowledge of the whole production chain. Another consideration is that maintenance activities are all times under pressure to reduce costs more than valuing the benefits or damages that it avoids (Carter 2001, Mitchell et al. 2002) to the company. Show of this importance, it is the weight of O&M activities in GDP, 9.4% in Spain (AEM 2005), and other international studies put it among the 15%–40% depending on sector (Mulcahy 1999, Mobley 2002).

The concurrence of these disciplines implies that it can be difficult to determine the appropriate decision every time.

On the other hand, we can define a service provider company as those that provide clients certain services that are supported and distributed by a network infrastructure, such as gas companies, water, electricity, telecommunications, etc. This infrastructure is often organized and composed of elements prepared in hierarchical structures and replicated by areas of distribution (Fig. 1). These companies fulfill the following characteristics:

1. Elements geographically dispersed and in conditions of environment not optimal
2. High number of interconnected elements
3. High number and classes customers
4. Hierarchical structure in networks with levels of aggregation of customer service
5. The network is dynamic and suffers configurational and operational changes
6. High needs of human resources and spares

In these types of enterprises, maintenance is a key department (Earl 1994), by its contribution to look
after the interests or satisfy the needs of clients and benefits of enterprises (Zhu et al. 2002).

There are five different types of maintaining to consider for these types of enterprises according to most of the standards (Crespo 2007, Benoit 2006, Levitt 2003, Wireman 1991):

1. Corrective Maintenance.
2. Preventive Maintenance.
4. Proactive Maintenance, a set of activities designed to detect and correct an incidence before it occurs avoiding its effects within the network and in services (Tanenbaum 1991).
5. Perfective Maintenance. In the spirit of continuous improvement (IEEE 1219 1993, UNE 66174 2003) In the spirit of continuing improvement it is a set of projects to improve the performance of the network using the knowledge of maintenance (Kent 1990), also called “Design-out Maintenance (DOM)” (Gelders & Pintelon 1988).

4 OUTSOURCING AND MANAGEMENT IN SERVICES PROVIDERS

There are many standards models of processes, best practices, and Information Technologies facilities (Hammer 1990, Peters 1982), unfortunately “no single model works in all conditions”. Some of which referencing will seek to take advantage:

- EFQM (2006), TPM (Nakajima 1992) and ISO 9001 (2001), management by process and quality
- ITIL (ITSMF 2007), e-business
- eTOM (2007), network management
- CMMI (2007), system management to evaluate maturity of companies

The initial situation of the majority of organizations in distribution services are characterized by:

- Management of a high set of elements from a large number of suppliers
- High dedication to resolution of incidents
- Operation not automated, manual, dedication to repetitive tasks
- Reactive management before occurrences
- Network documentation in paper format
- Absence of unique and updated inventory

The situation tends to become more complex: increasingly difficult to manage systems due to increased volume and large geographic dispersion. Therefore, this situation as a starting point for a process of outsourcing is not the most appropriate.

Recommendation for outsourcing is to establish a structured management model in maintenance, as a redesign (Davenport 1993, Hammer 1993) based on activities, and with objectives of ensuring service quality (Klein 1994), so that it facilitates decision-making and finds points of improvement more quickly and easily. In sum, a model “oriented to customers, processes and services delivery” (Fig. 2). Then, we develop our model is intended to be a support for outsourcing in maintenance, searching:

- Balance between the fulfillment of internal and external requirements; strategic, operational and tactical (Kaplan and Norton 1996)
- Transform resources and services in customer satisfaction, fulfilling specifications and restrictions on management and cost (Nakajima 1992)

Then the implantation of the reference model is developed in the following six phases (Fig. 3):

4.1 Mission, objectives and responsibilities

The definition of European standard UNE 13306 (2001) about maintenance management is quite comprehensive, although we have to identify the mission of maintenance to complete that definition according
to the characteristics of the services providers companies: “guarantee the service”, to ensure the proper functioning of the services supplied. And starting from this mission, we define responsibilities to get the objectives of the department.

4.2 Strategic maintenance outsourcing plan
This phase establishes a strategy to achieve the goal and maintain a solid and operational network that ensures services, according to requirements set by the organization. Strategy is based on three interrelated viewpoints: improvement of services quality, cost reduction and resources optimization.

4.3 Processes and activities definition
Set all necessary functions to carry out the strategies and to structure them in processes and activities. To categorize activities by their strategic value, as their employment in cost and resources, as for their contribution to quality, taking into account the type of knowledge in which is based and the control possibilities. In this point, it will determine whether the implementation of these activities should be carried out with internal or external resources (Fixler & Siegel 1999, Grossman & Helpman 2002). It is important not to forget that within outsourcing costs, we can appreciate further preparation, implementation, maintenance and completion.

4.4 Outsourcing knowledge and documentation in maintenance control system
This is where it should establish maintenance control system and where it defines the way to assess outsourcing and maintenance, in search of efficiency, through a balance between quality and cost. The implementation of a complete management system can reduce between 10–30% of the annual budget of maintenance (Crain 2003, PMRC 2004), highlighting the main improvements upon cost and task control, vital in the control of outsourcing.

In addition, based on Campbell and Jardine (2001) and standards, we can consider that the minimum support systems for a Computerized System Maintenance Management System (CMMS), also called (MMIS) Maintenance Management Information System (Pintelon & Gelders 1992) are six (Fig. 3):

4.4.1 Inventory system
A correct management of the configuration within a network ensures rigorous bulletins and organization (ITSMF 2007), which maintains a history about the evolution of elements in a planned manner. So it reduces the risk of loss of control, ageing and variations in service quality.

4.4.2 Monitoring system
It is key point for proactivity in maintenance. It provides information in real time about status of the network and services (Lee 1995) with the objective to ensure maximum network availability (Yan 2003), with the highest quality, in a rapid and effective response for incidents, preventing potential problems before they start (IMSCENTER 2007).

4.4.3 Activities and resources management system
Its mission is managing, planning and documenting categorizing activities associated with human resources and infrastructure elements. Therefore it is characterized by encompassing knowledge management of historical data as a source for managing problems (symptom-cause-solution) and learning. This module is the integration between technology and social variables: tasks, resources, personnel and organization (Earl 1994). Activities have to be automatic by work-flow systems to provide increased levels of availability, reliability, flexibility and speed of services from the point of view of technical and economic.

4.4.4 Integration module with the rest of company systems
This module has an objective to allow impact analysis in maintenance from the point of view of business operations and clients (Lee 2004). Interconnection must be conducted and controlled, at least with the following enterprise systems:

- Economics system
- Human resources management system
- Logistics
• CRM, Customer Relationship Management
• Documentary management system
• Knowledge management system.

4.4.5 Balance scorecard in maintenance and with other systems
The balance scorecard is a pillar in evaluation and control of compliance with the department objectives. Its aims are alignment of the department with company strategy; relates all activities, processes, systems and resources all with the operational objectives and strategic (UNE 66174 2003, UNE 66175 2003, Kaplan & Norton 1996).

To this end, it collects a coherent set of indicators, financial, about business, customer relationship and continuous improvement.

4.4.6 Expert support system for taking decisions
This system gives support to take decision with maximum information, to facilitate the achievement of objectives (Davis 1988). The recommendation is to be formed as a module that integrates:

1. Decision Support System for decision making (DSS) (Turban 1988, Bui & Jarke 1984) through scientific models based on all the information from the systems.
2. Expert System (ESs) (Shu-Hsien 2005) to emulate through artificial intelligence, human reasoning like an expert.

This module applies both, information management, as statistical models (Marple 1987) and simulations to submit patterns and solutions to facilitate decision making in maintenance (Iserman 1984, Jardine & Banjевич 2006).

4.5 Supplier selection
Once the reach of outsourcing is defined, from a stable situation, it proceeds to supplier selection and the planning of outsourcing implementation. There are many considerations to take into account during this negotiation to avoid the risks listed above, but the main point is that it is a collaborative negotiation or win-to-win process, with the supplier as a strategic partner. It is advisable to guide suppliers to offer services based on levels of their knowledge, and thus avoid the approach to only reducing cost.

Aspects most favoured to select a supplier are:
• Experience in a sector
• Flexibility on demand for services
• Confidence
• Technical and economic solvency
• Will of collaboration oriented to services as strategic support
• Transparency of suitable pricing

4.6 Management of changes
Planning correct transition is important, it is a learning phase oriented to the supplier for fulfilling agreed service levels. On the other hand, to ensure business continuity in outsourcing, it should also be considered a transitional phase and, a possible reversion distinguishing if it occurs in the transitional phase, at any time, or at the end of contract.

To work with an outsourcing model of these characteristics implies important changes for everyone, especially those teams responsible that have to take a much more participatory role in management.

5 A CASE STUDY IN A TELECOMMUNICATIONS COMPANY
As an example, to simplify, we will only focus on the outsourcing decision in a telecommunications provider to evaluate importance of each activity by its contribution towards the maintenance goals and to decide that activities could be outsourced.

From a strategic point of view, (Kaplan & Norton 1996, Campbell & Jardine 2001, EFQM 2006), it must abide by basic maintenance objectives, which summarize in the following six categories:
1. Management
2. Economical
3. Production or business
4. Quality or related to customers
5. Security, environmental and ethics
6. Evolution and Improvement

On the other hand, from a tactical point of view processes of the department should also be taken into account: corrective, preventive, predictive, proactive and perfective.

From an operational point of view, it has to consider maintenance activities. to simplify the study, within these activities, only the most important activities are considered.

1. To manage incidents, all kinds of incidences
2. Monitoring alarms and status of network and services
3. On demand activities, to support other internal departments in field
4. Preventive activities
5. Predictive activities, analysis to avoid or minimize future impacts
6. Perfective activities. Improvement plans or tasks to optimize infrastructure and services
7. Logistics. Stores management and spares
8. Budget and human resources. To control of budget, resources, tools, staff, vehicles, etc . . .
9. Security. To control security, health and safety risks
10. Documentation and compilation of processes, procedures, reports, etc . . .
Table 1. Relative Importance between variables. Saaty scales.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same</td>
<td>Weak</td>
<td>Strong</td>
<td>Proven</td>
<td>Absolute</td>
<td></td>
</tr>
<tr>
<td>1/3</td>
<td>1/5</td>
<td>1/7</td>
<td>1/9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slightly less</td>
<td>Less</td>
<td>Much less</td>
<td>Absolute less</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1/2, 1/4, 1/6, 1/8, 2, 4, 6, 8) Intermediate values if it is necessary

Table 2. Index of comparisons randomly generated.

<table>
<thead>
<tr>
<th>ICrandom</th>
<th>0</th>
<th>0.58</th>
<th>0.9</th>
<th>1.12</th>
<th>1.24</th>
<th>1.32</th>
<th>1.41</th>
<th>1.45</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

For decision-making, we rely on properties of the AHP method (Saaty 1977, 1980, 1990) for decisions in group (Dyer & Forman 1992) of selected maintenance experts from several hierarchical levels. The Analytic Hierarchy Process “AHP” is a methodology to synthesize a solution (a matrix) of a complex problem through a breakdown in parts ordered hierarchically, quantifying and comparing variables in pairs with a normalized and reciprocal scale of relative importance (Tab. 1).

In the use of this method, it can use subjective values, which implies a degree of uncertainty or lack of reliability. To measure reliability coefficient “RC” is used ratio between rate of consistency IC of a comparisons array into pairs and value of the same index of a comparisons array into pairs randomly generated (Tab. 2). The reliability is sufficient if RC is smaller than or equal to 0.10; otherwise, it must be reviewed to improve its consistency.

\[
RC = \frac{IC}{IC_{random}} \leq 0.1 \tag{1}
\]

\[
IC = \frac{\lambda_{max} - n}{n - 1} \tag{2}
\]

So, the problem is hierarchically structuring with criteria and alternatives, in three levels:

1. Goal
2. Maintenance objectives as criteria
3. Activities as alternatives

For valuing objectives, it is used an expert group poll with qualitative criteria depending on their strategic importance. Each technician of a six group compares them employing table 1 and after, the resulting matrix (Fig. 5) is built weighing the average of individual values (Fig. 4), e.g. 0.21 (in the second cell of the first row in the figure 5 is calculated dividing geometric mean (3.086) of the six individual values (3 + 4 + 3 + 2 + 4 + 3) by the sum of the second column in the figure 4 (14.5), and at the same manner with the rest of the matrix.

Successive matrixes from activities compared according to each strategic objective were developed (with indices RC all less than 0.06, valid), with the exception of cost, where we employ the activity budget rate (quantitative criteria). These matrixes are multiplied by their respective eigenvector (W) to obtain in one column this contribution (Tab. 3).

In short, it obtains the weights for activities in the Table 4, multiplying each cell of the Table 3 by the respective cell in the same column of the W vector of the Figure 5. Then activities are ranked depending on their importance in relation with the objectives of maintenance:

1. Budget and Human Resources 17.70%
2. Documentation 13.96%
3. Predictive 13.58%
4. Perfective 12.15%
5. Monitoring 10.87%
6. Preventive 10.31%
7. Security 7.00%
8. Manage Incident 6.84%
9. Logistic 5.11%
In addition, it is possible to increase control and high depth and customization for certain scenarios. The expert group feels motivated with this decision by predictive and perfective maintenance, and as such can be developed in a service provider, it suggests that to compose facilities, “e-maintenance” (Yua et al. 2003, IMSCENTER 2007):

- Facilitate manage agreements on service levels and delivery service reports. Then IT contributes to effectiveness and efficiency.
- Orientation towards services more than elements of infrastructure, searching for continuous improvement in services and processes to reduce costs and times, and to improve value and quality.

The aim with this model is to increase decision reliability with experience, and in accordance with department strategy:

1. Improved organization and structure
2. Using a rational and logical analysis, it seeks a solution for a complex problem with various alternatives in conflict and in conditions of uncertainty [DIXON66]
3. Aligned with company strategy, it considers processes, objectives and activities
4. Employment qualitative criteria, to rationalize intangible quality and value judgments from experts to extract specialists knowledge
5. Promote positive attitudes towards improving maintenance
6. Consensus in groups with different interests
7. Categorize alternatives
8. Improve interactively
9. Report processes for future developments
10. Easy to use and flexible with information available

This method reduces time in decision making, increases quality and security of the final decision, and produces motivation and satisfaction with goals and team work.

In conclusion, according to maintenance outsourcing in a service provider, it suggests that to compose levels of externalisation progressively in time, increasing internal knowledge and control about activities before to recruit once. That is, to make a partial outsourcing:

- with a flexible contract
- guarantee business productivity through service level agreement
- devoting staff to manage contractual relationship and monitor services
- outsourcing should be guided primarily by strategic criteria

But it should carry out the analysis with caution, because in the case of outsourcing the level beyond the norm, there is a point of Irreversibility of decision where it would be impossible to react, this point is where the procedure to prevent consequences expressed would be unacceptable to act upon due to time and resources.

6 CONCLUSION

This reference model has been implemented in at least two companies in distribution of telecommunications services, and as such can be developed in a high depth and customization for certain scenarios. In addition, it is possible to increase control and knowledge in maintenance thanks to information systems facilities, “e-maintenance” (Yua et al. 2003, IMSCENTER 2007):

- Facilitate manage agreements on service levels and delivery service reports. Then IT contributes to effectiveness and efficiency.
- Orientation towards services more than elements of infrastructure, searching for continuous improvement in services and processes to reduce costs and times, and to improve value and quality.

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### Table 4. Matrix of activities rates according to their importance in relation with strategic objectives.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Quality</th>
<th>Cost</th>
<th>Production</th>
<th>Management</th>
<th>Security</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manage incident</td>
<td>0.019</td>
<td>0.004</td>
<td>0.019</td>
<td>0.004</td>
<td>0.016</td>
<td>0.066</td>
</tr>
<tr>
<td>Monitoring</td>
<td>0.015</td>
<td>0.008</td>
<td>0.027</td>
<td>0.004</td>
<td>0.032</td>
<td>0.023</td>
</tr>
<tr>
<td>On demand activities</td>
<td>0.004</td>
<td>0.002</td>
<td>0.005</td>
<td>0.002</td>
<td>0.008</td>
<td>0.004</td>
</tr>
<tr>
<td>Preventive</td>
<td>0.012</td>
<td>0.006</td>
<td>0.025</td>
<td>0.005</td>
<td>0.036</td>
<td>0.019</td>
</tr>
<tr>
<td>Predictive</td>
<td>0.026</td>
<td>0.008</td>
<td>0.031</td>
<td>0.008</td>
<td>0.034</td>
<td>0.029</td>
</tr>
<tr>
<td>Perfective</td>
<td>0.020</td>
<td>0.008</td>
<td>0.031</td>
<td>0.009</td>
<td>0.027</td>
<td>0.025</td>
</tr>
<tr>
<td>Logistics</td>
<td>0.006</td>
<td>0.005</td>
<td>0.019</td>
<td>0.002</td>
<td>0.012</td>
<td>0.008</td>
</tr>
<tr>
<td>Budget and Human R.</td>
<td>0.023</td>
<td>0.023</td>
<td>0.070</td>
<td>0.018</td>
<td>0.032</td>
<td>0.011</td>
</tr>
<tr>
<td>Security</td>
<td>0.010</td>
<td>0.004</td>
<td>0.009</td>
<td>0.002</td>
<td>0.034</td>
<td>0.011</td>
</tr>
<tr>
<td>Documentation</td>
<td>0.023</td>
<td>0.006</td>
<td>0.019</td>
<td>0.009</td>
<td>0.063</td>
<td>0.019</td>
</tr>
</tbody>
</table>

Figure 5. Weights in strategic criteria (RC = 0.01579, acceptable).

10. On demand activities 2.49%

This situation conducts processes of externalization towards these last four routine and repetitive activities with not crucial importance to the core business. The expert group feels motivated with this decision for participating, and it is suggested to advance more in outsourcing after a stable period externalizing:

- Monitoring, at least first attention level
- Preventive maintenance, guiding planning internally by predictive and perfective maintenance

This reference model has been implemented in at least two companies in distribution of telecommunications services, and as such can be developed in a high depth and customization for certain scenarios. In addition, it is possible to increase control and
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