Performance measurement systems in after-sales service: an integrated framework

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Abstract: In today's competitive markets, companies are shifting from a Productcentric to a Customercentric view. The After-Sales (AS) service can become a key differentiator and a major profit source. Thus, after-sales cannot be considered simply a set of operative activities; rather it plays a strategic role, affecting the definition of the product-service mix offered to the customer and the physical and organisational configuration of the overall logistics chain. Therefore, importance should be given to its strategic management and to the definition of a structured business performance measurement system. In this context, this paper a) provides a review of the existing body of knowledge about AS performance measurement systems, b) proposes an integrated framework for AS performance measurement consisting of four levels (business, process, activity, and development and innovation), and c) provides an empirical application of the framework to four case studies in durable consumer goods – automotive, home appliances and consumer electronics.

Keywords: After-Sales (AS) service; performance measurement systems; reference model; case studies; durable goods.

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1 Introduction

Over the past years, as sales growth in the durable-goods market has slowed and product margins have decreased, the After-Sales (AS) activities – those activities taking place after the purchase of the product and devoted to supporting customers in the usage and disposal of the goods – have become increasingly important as sources of differentiation and profit for manufacturers. Therefore, a shift in emphasis is taking place, from a traditional *productcentric* view to a more innovative *customercentric* view.

The relevance of AS service is demonstrated by the profit it generates, often higher than the one obtained with the products' sales: the service market can be four or five times larger than the market for products (Bundschuh and Dezvane, 2003) and may generate at least three times the turnover of the original purchase during a given product's life cycle (Alexander *et al*., 2002; Wise and Baumgartner, 1999), contributing about 40%–50% of the total revenue, and a profitability of up to 20%–25% (McClusky, 2002; Alexander *et al*., 2002; Craemer-Kühn *et al*., 2002).

These figures may explain the change in the role attributed to the AS function, traditionally seen only as a cost generator and a 'necessary evil', in favour of a more proactive one, which considers the AS as a source of competitive advantage and business opportunity. Therefore, the AS service should not be viewed simply as a set of operational activities, but rather as an integrated process to be managed with a systemic approach. As a consequence, a significant effort should be devoted to the strategic management of AS and to the definition of a structured performance measurement system.

In this context, this paper proposes:

1 a review of the existing body of literature about AS performance measurement systems

2 a new integrated framework for AS performance measurement

3 to provide an empirical application to four case studies in durable consumer-goods industries.

Therefore, the paper is divided and organised as follows. The next section introduces the characteristics of the AS service. Section 3 presents a literature review on performance measurement systems and on their specific applications in the AS service. Section 4 describes the proposed reference framework for AS performance measurement. Section 5 provides an empirical application on four in-depth industrial cases belonging to the automotive, home appliance and consumer electronics industries. Finally, Section 6 draws some conclusions and suggests directions for future research.

2 Characteristics of the after-sales service

Several definitions of AS service can be found in managerial literature. They mainly differ with respect to both the extension assigned to the concept of AS and its role inside the value chain (Cohen and Lee, 1990; Ehinlanwo and Zairi, 1996; Asugman *et al*., 1997; Urbaniak, 2001). Despite the different definitions, some peculiar features of the AS service can be pointed out (Patelli *et al*., 2004a):

a AS represents a business

b AS is a service

c AS is a process, consisting of different activities, carried out by actors belonging to different functions and organisations

d AS constitutes an organisational unit, with different possible economic responsibilities (cost centre, profit centre and investment centre)

e the AS process of a single company (*e.g.*, the product manufacturer) is part of a wider network, involving different actors (dealers, suppliers, technical assistance centres, logistic service providers, the final customers and so forth).

First of all, in most organisations AS represents a *business*, which can generate significant profitability, often greater than the one generated by product sales. AS represents a division and its management has to reach adequate financial results (costs, revenues, operating profit, Return On Assets (ROA), cash flow) and competitive performance (market share, market penetration, customer satisfaction and loyalty, competitors' results). In order to develop the AS business, a proper balance between the orientation to profitability and the one to customer satisfaction and loyalty, as well as an adequate level of investments, have to be assured, both in the short term, as well as in the long term. The design of a performance measurement system has to consider the peculiar strategy of the AS business and to carefully monitor its implementation.

Secondly, being a *service*, some characteristics of AS that are typical of services, and which play a significant role in profit generation and customer satisfaction, have to be considered, such as the distinction between front-office and back-office activities, the relevance of some intangible assets, such as human resources, the proximity to the customer, the relevance of indirect costs, the focus on the service level (quality and timeliness) (Fitzgerald *et al*., 1991). AS effectiveness depends mostly on front-office activities, while efficiency emanates from back-office ones. Moreover, in order to capture the contribution of intangibles, such as human resources or customer satisfaction, a set of operational and qualitative indicators which integrate the financial and quantitative ones has to be developed.

Thirdly, AS as a *process* can be viewed as the sum of activities needed to maintain product quality and reliability, sustained after the delivery took place, with the objective of increasing customer satisfaction (Ehinlanwo and Zairi, 1996). The efficiency and effectiveness of different activities impact on customer satisfaction, productivity and flexibility, in terms of responsiveness and service characteristics. Up until now, a recognised definition of activities which compose the AS process has not been developed. Only recently, a classification of AS activities has been proposed, which distinguishes between core and support macroactivities (Patelli *et al*., 2004b). The activities require different emphasis to be put on the efficiency and effectiveness dimension, being either front-office activities or back-office ones.

Therefore, AS performance ought to be monitored at the activity level, in order to link explicitly resource consumption by each activity to the appraisal of the functionality delivered to the customers, pointing out efficiency and effectiveness drivers.

Fourthly, AS represents an *organisational unit*. The manager in charge of it needs a set of performance measures which can help him/her to analyse the variances between budgeted goals and actual results; to evaluate strengths and weaknesses of the organisational unit and to support decisions. An integrated system of measures is required to monitor the AS performance, which can relate specific Key Performance Indicators (KPIs) for the AS services to the company's overall strategic goals, in order to assess the consistency between strategic and operational objectives. Indicators, in order to be meaningful, have to consider both financial results (revenue, cost or profit) and operational drivers of performance, such as quality and responsiveness.

Finally, AS is characterised by a *network* perspective. In order to coordinate different actors along the value chain (Ehinlanwo and Zairi, 1996; Seuring, 2002), an integrated and multi-level set of measures needs to be properly designed.

The description of the main characteristics of AS provided in this section shows the need for a comprehensive evaluation of the AS service through a systemic perspective, which considers all the peculiar features of AS and identifies the characteristics that performance metrics should possess.

3 Performance measurement and after-sales service

3.1 Performance measurement systems

A plethora of literature concerning performance measurement systems exists. From the early 1980s up to the 1990s, most of the developed frameworks focused on the definition of performance attributes and on the classification of related measures. Different criteria for identifying critical aspects and attributes of performance have been pointed out

(Venkatraman and Ramanujam, 1986; Voyer, 1999). Most of the frameworks, in addition, addressed the corporate level and the strategic business areas (Kaplan and Norton, 1992; 1996; Olve *et al*., 1997). Moreover, activities and processes were identified as relevant aspects of performance (Kaplan and Johnson, 1987; Johnson, 1992; Lorino, 1995; Lorino *et al*., 1997; Wright and Keegan, 1997). The need to integrate traditional financial measures, such as Return On Equity (ROE) and Return On Investment (ROI), with both shareholder value indicators (economic value added, economic profit, *etc*.) and non-financial measures, was pointed out (Eccles, 1991; Stewart, 1991). The importance of integrating long-term measures, related to strategic planning, and short-term indicators, based on budget, in order to link those measures with the actions, organisation's mission and strategic objectives, was also pointed out (Tonchia, 2000). Moreover, the need to consider both tangible and intangible aspects, as well as efficiency and effectiveness, and innovation, was stressed. Different features of performance measures were pointed out: they have to be dynamic, relevant, timely, multi-dimensional, internal and external, in order to compare an organisation's results with competitors' performance, and also capable of predicting future outcomes rather than backward looking (Dixon *et al*., 1990; Lynch and Cross, 1991; Bititci *et al*., 2000).

The performance measurement frameworks developed in the 1990s most often aimed at linking strategy formulation to strategy implementation, long-term goals and decisions to short-term objectives and actions, by pointing out the relationship between performance drivers and competitive and financial results. Among the most popular and relevant models were the Performance Measurement Matrix (Keegan *et al*., 1989), the Results and Determinants framework (Fitzgerald *et al*., 1991), the SMART Pyramid (Lynch and Cross, 1991), the Balanced Scorecard (Kaplan and Norton, 1992; 1996) and the EFQM framework (EFQM, 1998; Olve *et al*., 1997).

Since the late 1990s, on the other hand, frameworks in literature considered explicitly new dimensions of performance: stakeholder satisfaction (Atkinson *et al*., 1997), corporate social responsibility and sustainability, intangibles and the supply chain.[1] Although all the listed frameworks consider several performance attributes and areas, they do not refer explicitly to the AS service. However, they can help in defining how to capture and measure the performance dimensions which distinguish the AS, since they point out all the relevant levels that can be applied to the evaluation of the AS service: strategic business area, process, activity and innovation.

3.2 Performance measurement in the after-sales service

Although in most manufacturing sectors AS is considered a key ingredient of competitive success (Cohen and Lee, 1990), few authors (if any) developed integrated performance measurement systems for the AS process as a whole. This section reviews the applications of the concepts of performance measurement to the AS service. From the analysis of existing literature, four theoretical perspectives and their approach to the measurement of AS service performance can be easily identified:

1 the product life cycle literature

2 the AS strategy literature

3 the spare-parts logistics literature

4 the supply chain and process-oriented approach.

3.2.1 The product life cycle literature

The life cycle perspective is founded on the integrated view of activities going from the initial product design to its dismissal/substitution by the end customer, so that a multi-activity and inter-organisational approach should be developed in order to measure all the relevant costs (Fabrychy and Blanchard, 1991; Artto, 1994). According to Shields and Young (1991), AS should be analysed from a customer perspective and a societal one, both being concerned with the support and disposal of the product. *Design for serviceability* is identified among the techniques for cost reduction in a life cycle perspective. Analysing the design and renewal of services, Meyer and DeTore (2001), moreover, apply a platform-based approach (*e.g.*, the modular architecture typical of product development) to the development of services. Target Costing and Life Cycle Costing (LCC), which allow a company to plan and manage jointly price, cost and profitability as well as time, quality and functionality in the product life cycle (Cooper, 1995; Cooper and Slagmulder, 1999; 2003), do not take into account the impact on AS (Lele, 1986; Goffin, 1990; 2000). In addition, Cohen *et al*. (1997) stress the importance of joint consideration of the AS service function revenue with the product sales revenue on a full ownership life cycle basis. Cohen and Whang (1997) developed a product life cycle model to study the strategic choices facing manufacturers of durable goods in the design of the product-service bundle. Moreover, the importance of assessing the costs suffered by the customer – either a business or a private one – with a life cycle horizon, arises; thus the diffusion of the Total Cost of Ownership (TCO) approach, which is aimed at understanding the true cost of buying a particular good or service from a particular supplier (Ellram, 1995).

A life cycle approach to the development of the product-service bundle is stressed in the works of Goffin (1998) and Goffin and New (2001): customer support is a focal element in the reach of customer satisfaction, and thus impacts on firms' market share and financial performance. Product-support requirements have therefore to be considered in the product design stage. Edvardsson (1997) highlights the role of new service development as the phases in which the foundations for total quality for customers should be built in. Along with Edvardsson (1997), other authors, such as Bullinger *et al*. (2003), Tax and Stuart (1997), Berry and Lampo (2000) and Froehle *et al*. (2000), analyse the new service-development process and propose conceptual frameworks for the design or redesign of services. As well as product innovation, service innovation is therefore widely recognised as a source of sustainable competitive advantage.

The foregoing brief review suggests that life cycle literature favours a financial accounting (costs and revenue are evaluated) and long-term (the product life-cycle) oriented perspective for the AS performance measurement. The AS is evaluated in terms of its contribution to value creation for the company, at a strategic business level. The innovation dimension, moreover, is taken into consideration. Only the TCO approach considers the activity performed, but for what performances are concerned, focuses on cost measures. On the contrary, specific short-term AS performance metrics stay conspicuous because of their absence.

3.2.2 The AS strategy literature

Only some years after the seminal work by Levitt (1983), business and operations management literature addressed the issue of the AS support strategy. Armistead and Clark (1991) related the AS strategy to the design of the delivery system, in particular in relation with the volume and the level of insourcing, the class of product (capital vs. consumer goods), and the phase of product life cycle. Moreover, the authors stressed the importance of the consistency of AS capabilities with the critical success factors of its context, as well as the strong dependency between AS and manufacturing delivery systems: both should be monitored in order to evaluate an overall customer confidence index. Frambach *et al*. (1997) set as the main success element of a product-service strategy the assessment of the relative importance of different AS services to market segments. Lawless and Fisher (1990) identified the related services (intangibles) as one of the elements affecting nonimitability, and thus durable competitive advantage of new products. Also, Mathieu (2001) defined goods-related services as a source of competitive advantage; moreover, she classified them into services which support the products and services which support the client actions in relation with the product. In the three previously quoted works, nothing is proposed at the level of performance measurement.

According to Lele (1997), the critical factor that influences the strategy formulation is the amount of costs, fixed (*i.e.*, not depending on the downtime) and variable (*i.e.*, depending on the downtime), incurred by the customer in the case of product failure. The proposed approach distinguishes three classes of strategies that allow reaching cost-effective configurations of the AS service on the basis of different customers needs and product specifications. The three classes pointed out by Lele are product-design–related strategies, strategies focused on service support systems and strategies aimed at reducing customer risks. More recently, Agnihothri *et al*. (2002) focused on field service, and on the role and influence of technology in creating an effective service organisation. They pointed out the management of three relationships – company-customer, company-(its own) employees, and (company's) employees-customer – as the critical factor for ensuring service effectiveness. In addition, they proposed measures to assess the three above-mentioned relationships.

However, the theoretical frameworks in literature concerning AS service strategy do not, in general, adopt an integrated view of the performance measurement system. Performance evaluation is considered only at the strategic business level, and no detail is given on the definition of metrics. Moreover, the innovation dimension is not considered by most of the quoted papers. Finally, only Agnihothri *et al*. (2002) suggested a set of performance metrics as a tool to test and verify the coherence between the strategic objectives and the effect of the actions undertaken.

3.2.3 The spare-parts logistics literature

Most existing literature related to the AS operations focuses on spare parts inventory and distribution management. From the point of view of performance measures, they are generally oriented to internal service-level metrics (*e.g.*, part fill rates), sometimes neglecting the assessment of the level of service received by the end customer. On these bases, a stream of publications studied the issues of spare parts inventory planning (Papadopoulus, 1996; Hopp *et al*., 1999; Zhang *et al*., 2001; Huiskonen, 2001; Kennedy *et al*., 2002). Approaching the service performance issue from a logistics standpoint,

Cohen and Lee (1990) defined some internal-oriented service measures, such as the part unit fill rate, the part dollar fill rate, the order fill rate, and external-oriented ones, such as the repair-order completion rate and the customer delay time. Moreover, they stressed the trade-off between inventory costs and service (response time). Among the other works emphasising the trade-off concept, we find Cohen *et al*. (1997), Agnihothri *et al*. (2002) and PRTM (2002). Overall, the literature in this section shows a narrow focus, often identifying AS with spare parts management and distribution activities. The performance measures proposed by literature in this area, even if often very detailed, are only operative and mostly focused on a specific activity or a set of activities. Moreover, they assess a single company's efficiency and effectiveness, rather than those of the entire supply chain, but their effects on the final customer (*e.g.*, response time, cost) are not considered.

3.2.4 The supply chain and process-oriented approach

A supply-chain oriented approach to the AS performance measurement is envisaged, for instance, by Cohen and Lee (1990), who highlight how:

a end-customer oriented service measures should be implemented

b service measures should be applied to all the parties involved in the supply chain (*e.g.*, suppliers, Original Equipment Manufacturers (OEMs), dealers, warehouses, technical assistance centres).

Nonetheless, the Supply Chain Operations Reference (SCOR) model (Supply Chain Council, 2003), a well-known model for the analysis and assessment of supply chain processes, does not encompass the AS as a process in itself. However, some of the activities constituting the AS process, *i.e.*, the logistic and materials management ones, are mapped and evaluated in the SCOR model. For instance, the 'return' process describes the reverse flows that may be related to AS. It encompasses three types of return flows: return of a defective product, return of a product for maintenance, repair or overhaul, and return of an excess product. On the other hand, other specific activities of AS, such as service delivery, customer care, training, and so forth, are not considered by the SCOR model.

Broadly speaking, works approaching the AS as a process and thus oriented to the definition of process measures are almost absent in literature. A notable exception is provided by Patton and Bleuel (2000), whose work touches the different areas related to AS, from budgeting and service forecasting to the definition of the organisational structure, the training, marketing and inventory management activities. Moreover, they deal with the issue of performance measurement; nonetheless, their perspective is only operational. In fact, they provide a list of service attributes to evaluate, along with possible indicators, without an integrated, multi-level approach. The aspects of customer satisfaction and service quality measurement are also approached, but no comprehensive framework is given. Together with Patton and Bleuel (2000), among the first attempts to fill the gap on integrated AS performance measurement is the work by Patelli *et al*. (2004b). They provide a definition of the AS service, seen as a business network process that involves different actors (Earl and Khan, 1994); moreover they identify AS's main constituting subprocesses and propose an activity-based costing (Innes and Mitchell,

1990) approach to its financial performance measurement. For the same sub-processes, Brun *et al*. (2004) identify performance attributes in the areas of service quality, timeliness, efficiency and costs.

This approach, as compared to others, proposes a rather integrated perspective, in terms of activities and actors involved. Nonetheless, it focuses mainly on operative aspects, often neglecting an assessment at the strategic level. This stream of literature is relatively new, and no established theory or conceptual model seems to exist at the moment.

In conclusion, literature dealing with the AS service presents a highly fragmented picture, where a systemic approach connecting the strategic aspects of AS service, a supply chain and process perspective, with a consistent set of performance metrics, is still lacking. None of the analysed streams of literature, in fact, addresses all the different characteristics of AS described in Section 2. Moreover, the attention devoted to performance metrics is weak. The only works that propose detailed performance metrics (Cohen *et al*., 1997; Supply Chain Council, 2003) deal with only some operative activities.

4 Reference framework

Despite the key role AS has assumed in the last few years, the previous section shows that there are few, if any, comprehensive and consistent applications of well-known performance measurement frameworks to the AS service in manufacturing firms, or little development of new ones. Therefore this paper aims at proposing an integrated reference framework for AS performance measurement.

A performance measurement system for the AS has to take into account its peculiar drivers of efficiency and effectiveness, by considering its typical features (see Section 2): at the OEM level, AS is at the same time a business, a process, a service and an organisational unit. Literature on performance measurement systems, described in Section 3.1, can suggest criteria to identify an organic system of metrics and indicators for AS:

1 An effective performance measurement system has to be articulated according to different *levels of analysis*, in order to drill down objectives and results consistently with relevant dimensions of analysis (strategic business area, process and activities, organisational units, supply chain).

2 At each level, it has to refer to different *aspects and dimensions of performance*, in order to capture all the critical aspects of AS.

3 It has to balance financial and non-financial indicators, in order to relate the operative drivers with the financial results (cause and effects).

4 It should encompass both long-term and short-term perspectives, tangible and intangible aspects, efficiency- and effectiveness-oriented measures.

The integrated framework proposed in Figure 1 is addressed to companies operating in the AS business. The adopted perspective is the one of a single enterprise. The framework aims at:

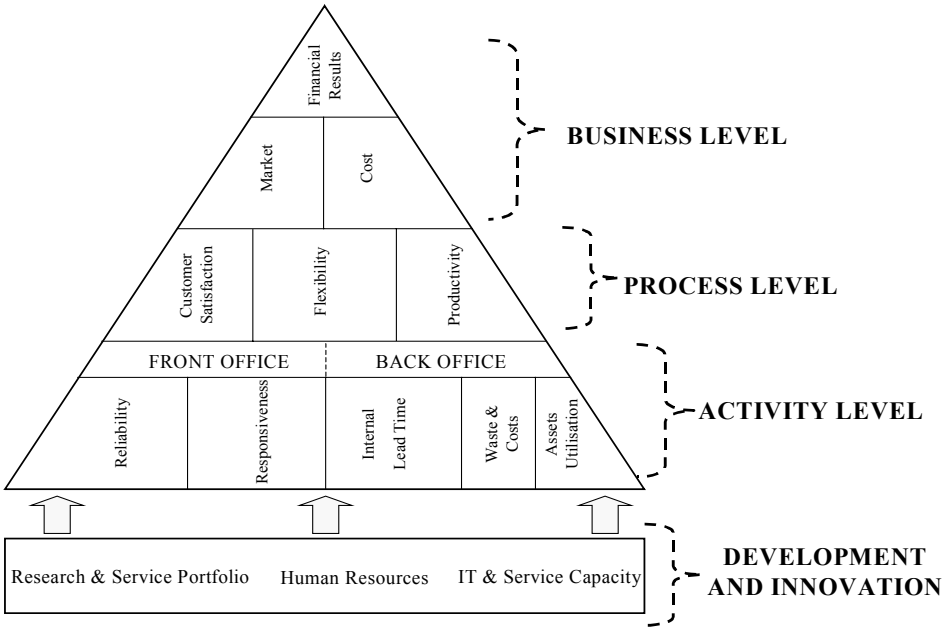
a supporting the design or the redesign of the performance measurement system

b assessing the consistency among the objectives and the performance metrics evaluated at the different levels of a single company framework

c describing and comparing the different performance systems adopted by different companies, or by one company across time.

The new framework is built by combining previous literature, in particular taking as a reference point Lynch and Cross (1991), Kaplan and Norton (1992) and the Supply Chain Council (2003). It links each peculiar feature of AS (see Section 2) with its related performance attribute, level and indicators. The framework distinguishes the short-term and the long-term perspective, as well as efficiency, effectiveness and innovation-related performance areas.

Figure 1 The After-Sales performance measurement framework



The framework is articulated in four levels:

1 business area

2 process level

3 activity level, whose performance measures are focused on the short term

4 development and innovation level, which considers a long-term perspective.

Only a stable and adequate investment in new services and products, human resources, IT and service capacity can ensure future profitability of AS. For this reason, the development and innovation level represents the base of the model, which 'feeds' in the long term all the other levels. The framework is systemic (encompassing different levels and areas), and hierarchical. The relationships exist among all levels, areas and indicators: the performance of lower levels and areas influence the results of the upper ones. The effectiveness-related performance areas (on the left side of the framework) are distinguished by the efficiency ones (on the right side of the framework). Different areas of performance at each level are defined and linked consistently with their impact on effectiveness or efficiency.

At the strategic business area level, the framework considers the overall AS performance, mainly a financial one. It can be measured by indicators such as operating profit, ROA and ROI. It is important to stress that the financial results are generated both by market results (market share, market penetration, *etc*.) that impact on revenue, and by the efficient consumption of resources (costs).

The second level in the framework is the process one. It is noteworthy to point out that the process is the linkage between the business's strategic objectives and specific activities carried out. A peculiar element of the model is the explicit recognition of the process as a specific measurement dimension. According to Lynch and Cross (1991), process performance can be measured with regard to customer satisfaction, flexibility and productivity. The customer satisfaction measures are devoted to identifying the existing gap between the expectations of the customer and the performance level of the firm, with regard to the characteristics of the output delivered. The flexibility measures the firm's ability to efficiently satisfy the customer expectations, both from an external perspective and an internal one (Lynch and Cross, 1991). The external perspective is related to the customisation of the output and its delivery time according to specific customer needs; the internal perspective is centred on the process lead time and the ability of the firm to manage activities fluently and without loss of time. Finally, the productivity indicators refer to the efficiency in resource consumption, and specifically to the link between resource consumption in the activities carried out and the output generated. It is noteworthy to point out that several companies evaluate those aspects, especially customer satisfaction, but focus on a single organisational unit or activity, without considering that they depend on the effectiveness and coordination at a process level.

The third level considers the performance of the AS organisational unit in dealing with its specific activities. It is useful to distinguish between front-office activities, impacting directly on customer satisfaction, and back-office ones, which are responsible for efficiency and lead times. Among the various works which dealt with the performance measurement at the activity level, we build on the Lynch and Cross and SCOR models. Lynch and Cross (1991) propose an explicit linkage between the performance metrics at the activity and at the process levels. For instance, reliability performance at the activity level impacts on the customer satisfaction at the process level. The performance attributes proposed at the activity level are quality, delivery, process time and cost. On the other hand, the SCOR model (Supply Chain Council, 2003) suggests other performance attributes to be evaluated at the activity level: reliability, responsiveness, flexibility, costs and assets. We agree with Lynch and Cross in considering flexibility to be a performance dimension characterising the process level. Therefore, integrating the two approaches, we point out five performance dimensions at the activity level: reliability, responsiveness,

internal lead times, waste and costs, and asset utilisation. *Reliability* refers to the performance of the AS in delivering the correct product/service to the correct place, at the correct time, in the correct conditions and packaging, in the correct quantity, with the correct documentation, to the correct customer. *Responsiveness* is the speed at which AS provides products and services to the customer. *Internal lead times* represent the speed at which back-office activities are carried out, while *waste and costs* refer to internal efficiency in the consumption of resources. Finally, *asset utilisation* refers to the effectiveness of AS in managing assets (fixed and working capital) to support demand satisfaction. Different indicators can be associated with each performance attribute. Reliability and responsiveness performance can be evaluated in the case of front-office activities, while internal lead time, waste, costs, and asset utilisation are assessed with regard to back-office activities.

Finally, the need to integrate the short-term with the long-term perspective, as suggested by Kaplan and Norton (1992), Fitzgerald and Moon (1996) and Fitzgerald *et al*. (1991), leads to the definition of a fourth level of performance measurement, assessing the development and innovation dimension. It aims at capturing the drivers of stable and adequate future competitive and financial results, through:

a investments in new products and services, which assure the renewal of product and service portfolio according to customer needs and competitors' actions

b investments in intangibles, such as human resources, which are particularly relevant in a service activity

c investments in infrastructures (IT and service capacity), which allow a balanced growth of AS volumes and profits.

The possibility to integrate the operating unit level, focused on activities, with the business and process levels allows companies to relate corporate strategic performance with operative ones and to assess the cause-and-effect relationship between operational drivers and financial and competitive results. It allows the monitoring and evaluation of the AS performance not only from a strategic and managerial point of view, which is of interest to top and middle management, but also with regard to the efficiency and effectiveness of single activities at an operational level, which are relevant to employees in charge of specific activities (material procurement, product installation, maintenance, spare parts delivery, *etc*.). Therefore, the framework helps to align the strategic vision and goals with the tactical and operational objectives, and the results of different operative activities.

In Table 1 an exemplification of the possible metrics that can be used at different levels is proposed. It is not an exhaustive list of indicators, but rather a suggestion based on a literature analysis and on the empirical research performed by the authors. The following section details the application of the framework to four different case situations, and compares the performance systems adopted by different companies.

Table 1 An exemplification of AS metrics

Area	*Metric*	*References*
Business level		
Financial results	Share growth; Cash flow; Return On Equity (ROE); Return On Sales (ROS); Return On Investment (ROI); Return On Assets (ROA); gross margin; profit growth; net profit/loss (%); equity ratio on industrial operations; equity ratio on financial operations; net revenues; net profit/loss per year, cash to cash cycle time.	Fitzgerald *et al.* (1991); Kaplan and Norton (1992); Lynch and Cross (1991); Case Studies
Market	Market share; market penetration	Fitzgerald *et al.* (1991); Kaplan and Norton (1992); Lynch and Cross (1991); Case Studies
Cost	AS service costs, AS personnel costs (total); AS personnel costs on total number of employees; AS overhead costs	Fitzgerald *et al.* (1991); Kaplan and Norton (1992); Lynch and Cross (1991); Case Studies
Process level		
Customer satisfaction	Customer Satisfaction Index (based on reliability, responsiveness, comfort, courtesy, competence, access, availability, security, aesthetics); expected AS service; perceived AS service; loyalty customer index; Service Reliability index; Repurchase Intent Index	Fitzgerald *et al.* (1991); Kaplan and Norton (1992); Lynch and Cross (1991); Parasuraman *et al.* (1988); Case Studies
Flexibility	Stock Rotation Index, Time To Market (service – product); service redesign frequency; N° of products/N° of services; upside source flexibility; AS variable costs on total costs (variable + fixed)	Fitzgerald *et al.* (1991); Lynch and Cross (1991); SCOR (2003); Case Studies
Productivity	Global productivity on cost basis: output value/input value, Break Even Time, Activity Rotation Index, Profit margin (on total AS service value)	Fitzgerald *et al.* (1991); Kaplan and Norton (1992); Lynch and Cross (1991); SCOR (2003); Case Studies

Table 1 An exemplification of AS metrics (continued)

	Reliability	*Responsiveness*	*Internal lead time*	*Cost and waste*	*Assets utilisation*
Activity level					
AS planning	AS planning forecast accuracy; % resources unavailability under request; fill and error rate	Time horizon and time interval on forecast accuracy; start-up time for a new service; average spare parts delivery time; maximum spare parts delivery time		AS planning cost per employee; service planning cost as a % of AS Costs; AS planning cost per hour	Inventory days of supply; human resources productivity
Inventory and distribution management	Fill and error rate; transportation damages on delivery	Warehousing service level; warehousing picking time; delivery time	Warehousing download time; warehousing picking time	Cost of picking errors; stock value; stock management cost on AS cost; inventory obsolescence as a % of total inventory	Transportation damages on supply
Procurement and supply management	Supplier delivery performance; supplier quality performance; supplier price performance		Procurement response time	Cost to measure supply chain performance as a % of revenue	Assets as a % of non conformance cost
Customer care	Total number of claims received; first level calls; number of resolved complaints; % of resolved complaints; % of immediate responses; number of customer care calls not fulfilled	Mean time to response; customer calls abandon rate; percentage of responses below time limit		Cost per registered claim; customer care total cost	Number of customers per customer care employee
Service delivery (including maintenance, repair and reporting)	Mean Time Between Failure; First Right First Time	Mean Time To Repair (MTTR); product reuse time (diagnosis time + MTTR); average spare parts delivery time; maximum spare parts delivery time; number of parts delivered in delay; delivery performance; on time delivery	Mean Time To Repair (MTTR); diagnosis time	Repair cost	Number of technical reports per month; frequency of network reports; number of technical reports per employee
Warehousing	Number of stock-outs per month; fill and error rate	Delivery time	Time between repairing and spare parts receiving	Stock value; stock management cost on AS cost; Inventory obsolescence as a % of total inventory	Inventory days of supply
Reverse logistics	Correct authorisation on product return/total authorisation			Rework costs; reverse logistic on AS; defective products stock value	

Note: Metrics listed are issued from the SCOR model and the case studies analysed

Table 1 An exemplification of AS metrics (continued)

Area	*Metric*	*References*
Development and innovation		
Service portfolio	Number of services offered; number of requested services not offered previously; availability of internal tyres centre	Fitzgerald *et al*. (1991); Kaplan and Norton (1992); Case Studies
A human resources	Frequency of training courses, number of courses per employee per year	Fitzgerald *et al*. (1991); Kaplan and Norton (1992); Case Studies
IT and service capacity	Number of installed equipment, number of available ramps; number of repair shops; number of AS personnel; number of warehouses (echelons); number of workers per repair shop; number of technical assistance centres; number of tester for diagnosis on line; number of technical reports per month; frequency of network reports	Fitzgerald *et al*. (1991); Kaplan and Norton (1992); Case Studies

5 Empirical application

5.1 Research design and methodology

A multiple-case studies research design was used to evaluate the framework proposed in the previous section. The sample is composed of four companies, operating in Italy and belonging to the automotive (Companies 1 and 2), white goods (Companies 3 and 4) and consumer electronics industries (Company 3). The cases allowed testing of the ability of the proposed framework to describe the performance measurement system developed by each company, with a systemic and integrated perspective. Assessing the relative attention given by the companies to the dimensions constituting the framework, it is also possible to compare the different approaches to AS performance measurement adopted by the companies and to investigate their causes.

Case studies were performed through semi-structured interviews, a detailed questionnaire (available from the authors upon request), direct observation (warehouse and company tours) and the analysis of secondary sources (such as company documentation, corporate website, specialised press).

Four to six visits to each company's unit were made. Informants included the AS managing director, the manager(s) in charge for AS in Italy, the spare parts warehouse and material planning managers, and the customer care manager. Data collection focused on research variables describing the company, its AS unit and the AS supply chain configuration. In particular, the issues related to performance measurement were explored in the cases at each of the levels described in the framework in Section 4. The several informants and the different data sources used allowed for triangulation, to check the internal consistency of data (Voss *et al*., 2002).

Finally, cross-case comparisons were made to identify main differences and common behaviours among companies (Yin, 1994).

The cases are reported in Section 5.2, while the interpretation according to the framework and the discussion are treated in Section 5.3.

5.2 Case studies

5.2.1 Company 1

Company 1 is the Italian branch of a successful European group, one of the world-leading automobile and motorcycle manufacturers in the premium sector. All the Italian activities are carried out in accordance with the headquarters' strategic decisions, whose main aim is to gear to a long-term profitable growth. The adopted sales and AS strategies are focused on protecting the 'brand experience': the company supports its profitable growth thanks to the strength and image of its brands, kept through price positioning and customer satisfaction, provided by high quality, technological innovation, safe and reliable products and a complete set of services.

The AS is organised as a division, directly reporting to the CEO and responsible for profits and losses. The AS organisation is divided into five main areas:

1 marketing spares and service

2 sales promotion and budgeting

3 product and warranty

4 customer relationship management

5 field operation management.

The latter has been specifically created to manage and control the 180 exclusivist assistance centres located in Italy. The strategic role that AS service plays for the company has affected the whole performance measurement system. The main indicators measuring the financial performance are revenues, equity, long-term debt, net profit/loss per year, equity ratio on industrial operations, cash flow, cash flow on capital expenditures and equity ratio on financial operations. The main competitive results evaluated are volume growth and market share.

From an operative point of view, the AS emphasis shifts towards the measurement of customer satisfaction. At an operative function level the focus is mainly on reliability (*e.g.*, fill and error rate, number of stock-outs per month), responsiveness (*e.g.*, warehousing service level, average and maximum spare parts delivery time, mean time of service delivery, mean time to response) and internal lead time (*e.g.*, mean time to repair). Company 1 measures several cost and asset utilisation indicators, of which the single-area operative cost, the order-line cost, and the stock rotation index are the main ones. Although the business unit invests a large amount of money and resources in research and service development, the performance measurement in this area is not highly developed. Only the network service capacity is evaluated: the main indicators used are the number of the installed equipment and the number of available ramps and repair shops.

5.2.2 Company 2

Company 2 is the Italian branch of one of the world-leading automakers, offering a full range of models from minivehicles to large trucks. The automotive business (including sales financing and services) accounted for a total sales of around €110 billion worldwide in 2003. The adopted strategy focuses on customer satisfaction, retention and loyalty in the long term. This strategy is pursued through four key principles:

1 product reliability, to satisfy customer needs through functionality, quality and time to market

2 supply chain configuration and coordination efforts, in accordance with the Just In Time (JIT) principles

3 hierarchical dependence of the logistic function on the marketing function, in order to emphasise the goals of brand image, customer satisfaction and retention

4 a performance measurement system consistent with the strategic and organisational variables.

The Italian branch (established in 1990) has known an exponential sales growth (from 15 000 vehicles sold in 1996 to 120 000 sold in 2002). Today it employs 170 people (80 in the AS unit). The AS business unit is responsible for the activities concerning spare parts management and distribution, assistance services, customer care, network support management and control. It can be divided into four main areas: customer and network technical support, logistics, customer relationship management and AS business development. In order to assure an efficient and effective JIT operation system, the

headquarters project and apply in the subsidiaries and the network (192 exclusivist official centres in Italy) the same organisational model, in which every function has to pursue the goal of customer retention in the whole product life cycle and where the management of processes is standardised according to the headquarters' guidelines.

At the business level, the emphasis is mostly put on evaluating and controlling competitive results, such as the market share. The AS performance measurement and control system, both at the company and the assistance network level, mainly focuses on operative aspects. Several indicators of efficiency and effectiveness are monitored. Depending on the process they refer to (logistics, AS business development, customer relationship management, technical assistance), they are related to customer satisfaction, flexibility and service productivity.

At the AS function, a wide set of metrics can be found, to evaluate reliability (*e.g.*, transportation damages on delivery, number of order-lines fulfilled, percent of requested parts available, total number of claims received, number of resolved complaints, percent of immediate responses, number of customer care calls not fulfilled); responsiveness (warehousing service level, customer calls abandon rate, response and repair time, percentage of responses below time limit, number of parts delivered in delay); internal lead time (*e.g.*, warehousing picking and download time, procurement response time, diagnosis time, time between repairing and spare parts receiving, transport time, invoice delivery time); costs (spare parts and technical assistance costs, cost of picking errors, transportation damages on supply); and asset utilisation (stock available per month, stock rotation index, number of technical reports per employee, percentage of equipment used).

Finally, the vision of AS service as a long-term competitive weapon, is reflected in many performance indicators used by Company 2 to evaluate and measure its service portfolio (*e.g.*, number of services offered, frequency of introduction of new services, number of requested services that were not offered previously); the AS human resources (*e.g.*, frequency of training courses, number of courses per employee per year); IT & Service Capacity (number of AS personnel, number of workers per repair shop, number of installed ramps, number of tester for diagnosis online, availability of internal tyre centres, number of technical assistance centres); and the communication effectiveness in the Service Supply Chain (*e.g.*, frequency of network reports, number of technical reports per month).

5.2.3 Company 3

Company 3 is a subsidiary of a successful multinational group operating in the household appliances and consumer electronics sectors, established in 1945. The company consists of 103 employees in Italy, where the company structure includes a sales-agent network, technical assistance centres and call centres (both outsourced). The total turnover of the Italian branch was around €630 million in 2003. Range of products (the company markets products from telephony, domestic refrigerators, screen monitors to professional printers), innovation and technology, positioning in the middle-high price sector, organisational flexibility and customer satisfaction are the factors on which the business strategy is based. The AS strategy stresses customer satisfaction as its main objective; it is carried out by supplying the customer with additional services and transferring technical culture to the assistance network, in order to improve its effectiveness.

The Italian branch is structured as follows: under the Managing Director there are four trade divisions subdivided by product lines, the general Marketing and the Service and Quality function. The AS service is managed by the Service and Quality function. The Italian assistance network is composed of 300 specialised centres. A required target service level is defined by contract, as well as a list of indicators and metrics used by Company 3 to evaluate and control the required performance of each assistance centre.

The focus on customer satisfaction and on operative activities of the AS function affects the whole performance measurement system. Although responsible for losses and profits, the AS division does not emphasise the performance measurement of economic and financial aspects. On the contrary, several indicators and metrics are used to evaluate, control and measure the AS processes and functions. At the process level AS is measured through customer satisfaction indicators. At the function level several indicators are managed and controlled to evaluate the service activities, considering reliability (*e.g.*, number of nonconformity, quantity of requested parts available in stock); responsiveness (*e.g.*, customer calls abandon rate, mean time to response, mean time of service delivery and spare parts delivery time); internal lead time (*e.g.*, immediate shipment ratio, time for providing spares at the network, procurement dispatching time, mean time to repair); and costs and asset utilisation (*e.g.*, percentage of warranty repairs on total, number of substitutions, spares consumption, warranty costs, rework costs, cost of quality control). Finally, for research and service development, Company 3 does not evaluate its service portfolio, AS human resources and IT & Service Capacity through specific indicators.

5.2.4 Company 4

Company 4 is a white-goods manufacturer based in northern Italy, with three production plants in Italy. Born as a capacity supplier, Company 4 developed into a major Italian manufacturer of cooking appliances, and then to a relevant player in the top-range cooking and other white-goods markets. It experienced a significant growth in the last decade, and now counts around 1000 employees worldwide and a turnover near €300 million. With a focus on the medium-high market segment, Company 4's overall strategy is aimed at preserving and improving its brand image.

The AS service function, organised on a geographical basis, employs about 50 people and reports directly to the CEO. Along with a few staff personnel (accounting, statistics, technical documentation), the AS function has three main branches, namely the spare parts logistics, the Italian technical assistance, and the foreign technical supervision and support. The objectives of AS service focus on customer retention and on the development of the company's brand through customer satisfaction. The technical assistance in Italy is carried out by around 200 centres throughout the country, all autonomous businesses authorised by Company 4 to repair products and to sell accessories. The AS function recently shifted from a cost centre to a profit one with the aim, first reached in 2003, to self-finance its activities. A structured performance and cost measurement system has been in place in Italy for five years. In 2004 it was replicated in the foreign branches. The emphasis is, on one side, on the operational performance of the service while, on the other side, a tight control on AS operating costs is maintained, in order to preserve the self-subsistence of the AS function.

At a business unit level, the Profit & Loss is realised for each branch of AS (spare-parts logistics, the Italian technical assistance, and the foreign technical supervision and support). At the process level, AS is measured considering customer satisfaction indicators. At the activity level the main evaluated indicators are responsiveness (*e.g.*, mean and max time of service delivery, average spares delivery time, percent of services below time limit) and reliability (number of service parts available, percent of resolved complaints, percent of immediate responses). Moreover, assistance centres' fidelity in buying spare parts from Company 4 is also assessed. Internal service (*e.g.*, spare parts shipments) is compared to the delivery time promised to direct customers. Finally, indicators are measured by Company 4 to evaluate its service portfolio (*e.g.*, number of offered services, number of service contracts), the AS human resources (*e.g.*, number of training courses per employee) and IT & Service Capacity (*e.g.*, number of AS personnel, number of warehouses).

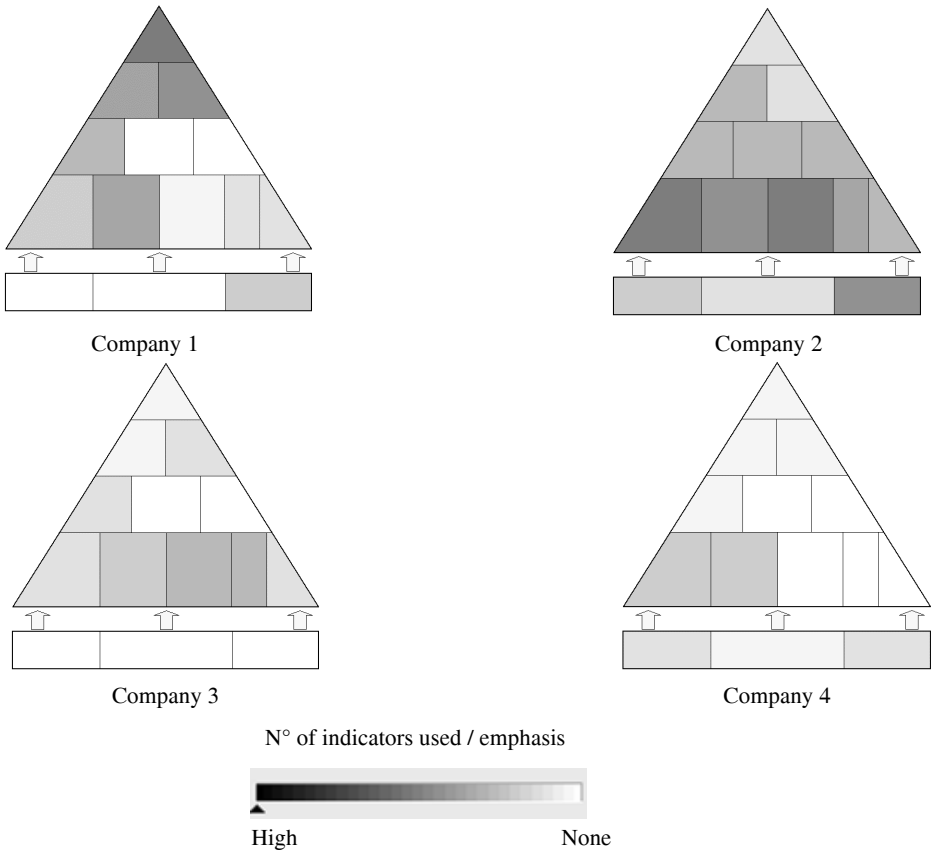
5.3 Discussion

In Figure 2, the main dimensions of performance measured by each company are mapped through the framework proposed in Section 4. For each company, each section of the diagram is filled with a different shade of grey according to the emphasis given to that specific performance area. Dark grey indicates that the company puts a high emphasis on the performance measurement of that area, and that multiple indicators are measured. The darker the grey, the higher the emphasis: the colour white indicates that a performance area is not measured by the company.

From Figure 2, it is possible to notice that case study companies implement AS performance measurement systems focusing on different aspects. Firms monitor different dimensions, going from financial results to competitive performance, from customer satisfaction and loyalty to process and activities' efficiency, and from lead time to quality. The dimensions differ according to the organisational level considered: strategic business unit, process, activities. The monitored aspects are both AS results (such as costs, profit, market share) and performance drivers (such as lead time, quality, customer satisfaction), but rarely is the relationship between drivers and results pointed out by companies. Some similarities among the case studies can be also pointed out. For instance, processes and activities are rarely considered dimensions of AS performance. Only Company 2, which adopts JIT principles, developed a common definition of processes also at the dealer level and implemented a consistent set of metrics. Company 2 is also the only firm which seems to cover adequately all the performance dimensions identified by the framework. The other companies rely on a (more or less) wide range of operational indicators not integrated in a systemic framework. All case studies show a link (explicit or, more often, implicit) between corporate strategic objectives, AS strategies and goals, and AS performance measures and indicators. However, apart from Company 2 and partially Company 4, firms adopt a short-term perspective on performance measurement, considering a budget horizon rather than a strategic planning one.

Figure 2 shows how the developed framework can serve as a descriptive tool, in order to draw a picture of a company's AS performance measurement system, and to develop a critical comparison of a set of companies, or a company over time.

Figure 2 Dimensions of performance mapped adopting the proposed framework



Interpretative power may be added to the framework by pointing out drivers that can explain the differences among companies and/or to evaluate the internal consistency of each company's behaviour. Table 2 shows a list of drivers and the positioning of each company, hereafter commented.

Table 2 Relevant drivers for the four case-study companies

Driver	*Company 1*	*Company 2*	*Company 3*	*Company 4*
Industry	Automotive	Automotive	Consumer Electronics – White goods	White goods
Size	Multinational	Multinational	Multinational	National
Product segment	Premium sector	Mass market	Mass market	Medium-high end
Time perspective (AS)	Short	Long	Short	Short
Economic responsibility (AS)	Profit and losses	Profit and losses	Profit and losses	Profit and losses

Company 1 and 2 belong to the automotive industry, which is rather advanced in terms of management techniques and which traditionally puts a high emphasis on performance measurement. This fact may explain why these companies assess, with high to medium emphasis, most performance areas. The generally lower emphasis on performance measurement of Company 4, moreover, may be due to its smaller size: it is the only national (Italian) company, addressing a European market. The product segment can act as a possible driver for the relative emphasis of efficiency and effectiveness measures: Company 1, acting in the premium segment, is more concerned with response times and customer satisfaction than with costs. The attention on the long term experienced by Company 2 shifts the relative emphasis towards the lower levels of the framework. Activity measures (low level of the pyramid) help in explaining the causes at the root of overall performance, while monitoring the capability of development and innovation supports the long-term strategic planning. Finally, the economic responsibility given to the AS organisation may explain the relative emphasis given to costs and competitive (revenue, market, *etc*.) measures.

6 Conclusions

The paper points out a gap between the increased relevance of AS services and the lack of integrated and systemic frameworks for AS performance measurement in literature. In order to fill (at least partially) this gap, we proposed a framework for AS performance measurement that combines the features of some existing models (such as the SMART Pyramid, the SCOR model and the Balanced Scorecard), integrating and adding to those models, in order to deal with the AS peculiarities described in Section 2. Consequently, the framework:

a addresses the AS at different levels from the business (and overall-results–oriented) one, to the process, activity and development/innovation ones

b addresses several performance areas at each level, giving emphasis to both efficiency and effectiveness performance

c at the same time, addresses internal and customer-oriented measures.

We believe that the framework may serve different situational needs: describing and comparing existing situations (*e.g.*, in an industry), interpreting and evaluating the differences, and designing or redesigning the AS performance measurement systems of a company, assessing the consistency among the objectives and the performance metrics.

The developed framework was applied to case studies from the automotive, consumer electronics and white-goods industries, showing the ability of the model to act as a descriptive tool for analysing and comparing different industrial realities (or a company across time). Interpretive power can be added to the framework by analysing specific drivers, such as the ones proposed in Table 1. This way, the different emphasis placed by firms on different levels and/or on different performance areas can be explained. The list of drivers proposed in this paper is not meant to be exhaustive, but rather should be viewed as a preliminary set, to be further developed. The aim of an enlarged and extended driver list is the analysis of the internal consistency of a company's AS performance measurement system (*e.g.*, with the company strategy, the product segment, the product life cycle phase, the type of customer addressed, the time perspective

emphasised and so forth), and a benchmark analysis (with direct competitors or cross-industry). Suggestions on how to align or improve the performance measurement system may stem from this analysis.

In addition, in the broader empirical research undertaken by the authors, a general need for managerial reference models in the AS service organisations emerged. The proposed framework, therefore, can be applied as a tool on which to base the definition of a company's AS performance measurement system. The example proposed in Table 1 should be further developed in order to define a practical measurement system for practitioners. The utilisation of the framework does not imply that each company should put emphasis or even monitor each performance area included in the framework, but rather should understand its priorities and define its own profile of measures and indicators consistently with the company strategy and the other drivers quoted above. However, the validation of the proposed framework requires a more extensive and exhaustive research, based mostly on in-depth case studies. Moreover, as already stressed, the list of interpretation drivers has to be completed, and their action mechanism explained in detail.

Finally, in the cases studied, relatively little emphasis has been placed on the companies' supply chains. The framework, like the SCOR model, is meant to be interlinked with similar frameworks for the other supply chain actors. Thus, all supply-chain tiers have to be studied in depth (through case studies and extensive research) and their performance measurement systems assessed, in order to check the internal and overall consistency of the AS performance measurement systems. This last issue constitutes perhaps the most important indication for future direction of research, in accordance with the development of the *supply chain, process-oriented approach* pointed out in Section 3.2.

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Note

1 The Value Reporting (Wright and Keegan, 1997), the Performance Prism (Neely *et al*., 2002), the Sustainable Balanced Scorecard (Epstein and Wisner, 2001; Figge *et al*., 2002), the SIGMA Sustainable Scorecard (www.sigma-project.org), the Intellectual Capital Model (Edvinsson and Malone, 1997; Sveiby, 1997; Stewart, 1999); the new balanced scorecard (Kaplan and Norton, 2004).