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Article *in* International Journal of Production Economics · January 2009

DOI: 10.1016/j.ijpe.2008.10.006

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Ground handling services at European hub airports: Development of a performance measurement system for benchmarking

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ARTICLE INFO

Article history:
Received 30 April 2008
Accepted 3 October 2008
Available online 25 October 2008

Keywords:
European union (EU)
Hub airports
Ground handling
Benchmarking
Action research

ABSTRACT

The liberalization of ground handling in Europe forces airports to assess their performance relative to their competitors in order to remain competitive and sustain long-term competitive advantage. Together with main EU hub airports, action research was conducted for one year to develop a holistic performance measurement system (PMS) for ramp services. The resulting PMS entails a process-based perspective and reflects the supply chain of airport logistics. As the findings of an ex-post validation suggest, the system represents a suitable basis for competitive benchmarking activities.

1. Introduction

Today's aviation industry is characterized by a highly dynamic and volatile business environment (Doganis, 2001, 2002). On the one hand it holds high growth potential (Air Transport Association, 2006; Bernabai, 2001), but on the other hand competition is intensifying (Garvens, 2005) and margins are decreasing (Francis et al., 2005).

Changes in the aviation business affect all members along the value chain (SAS, 2005). Competitive pressures not only occur on the "air side" of the value chain but are especially increasing on the "ground side" (Albers et al., 2005). In this context ground handlings' logistics are one of the biggest challenges and a main factor that determines sustainable success (Gonnord and Lawson, 2000; Wyld et al., 2005). Efficient and customized processes in the field of passenger, baggage and freight handling are therefore gaining paramount importance for airports and other logistics service providers (Oum et al., 2003).

The ground handling market has been facing a trend towards liberalization, which was induced by deregulation mechanisms implemented at the European level, such as the EU (European union) directive 96/67/EC which increases competition and cost pressure especially in the ramp handling sector (Fuhr, 2006; SH&E, 2002).

Ramp handling, as a major part of ground handling, can be seen as one of the primary functions of airports, subsuming all handling activities on the apron. It encompasses the activities of loading and unloading aeroplanes as well as the transport of passengers, crew, baggage, freight and mail between aeroplanes and terminal buildings. It represents the interface to the airlines on the one hand and the interface to airports infrastructure on the other hand.

Historically, air transportation used to be a highly regulated sector. Mobility was regarded as a good of public interest and regulation by the state was considered necessary. EU directive 96/67/EG was the basis for today's market structure and was published in the beginning of the 90 s to liberalize air transportation in Europe.

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doi:10.1016/j.ijpe.2008.10.006

The main goal was to induce a step-wise liberalization and to achieve a unified regulation of ground handling, particularly affecting the air side, so-called ramp handling. By opening the market a further aim was to reduce operating costs of air transportation and improving the quality of aircraft handling. Today the EU directive determines the number of ground handlers, which have to be enabled to enter the market (Soames, 1997). It makes limiting the number of providers only possible in exceptional cases. Moreover, changes in line with the latest discussion about a revision of the EU directive (European Commission, 2003) will further enforce liberalization of the ramp handling market.

Due to this increased competitive pressure, ground handlers and in particular ramp handlers will also have to rethink their strategies and structures as well as their scope of work (Müller et al., 2005) in order to maintain or gain long-term competitive advantage. As seen in other liberalized markets, today's ramp handling organizations need to become more competitive, market-oriented and customer-driven (Chan et al., 2006).

Therefore, it is particularly important for them to improve their ability to assess their own performance relative to that of their competitors (Oum et al., 2003). To achieve this, performance measurement can be seen as an adequate approach that permits a holistic analysis of their efficiency and effectiveness (Kennerley and Neely, 2002; Neely et al., 1995). As a sole usage of a performance measurement system (PMS) would not be "[…] able to answer one of the most fundamental questions of all—what are our competitors doing?" (Neely et al., 1995), benchmarking is considered as an appropriate tool that should be combined with performance measurement for the identification of best practice solutions among the industry (Francis et al., 2002). As such, the performance gaps provide an initial basis for targeting radical changes, as well as continuous improvement, both aimed at providing a long term competitive advantage.

Although benchmarking has been criticized to be limited Gregory (1993) and mainly provides information that helps to get on a par with other companies, it is an important method to take the first step in strategically positioning the company, identify the relative competitive position of a company (McIvor, 2003) and lay the foundations for a sustainable competitive advantage.

Within the scope of this article, performance measurement and benchmarking are seen as integrative approaches, whereby the PMS acts as the source of information for benchmarking activities. Nevertheless, such a system has not yet been developed for ramp handling businesses. Therefore, the research objectives of this article are twofold: The first objective is to develop an adequate PMS for analyzing the effectiveness and efficiency of ramp handling businesses. The second objective is to test its practical applicability for performing a benchmarking.

The next two sections provide a background on performance measurement, considering also the context of airport logistics. Based on this background, a conceptual PMS is presented. Then the action research methodology followed here is explained. The conceptually developed PMS was applied in a benchmarking study with several ramp handling organizations of EU hub airports. The article closes with a summary of the main findings, suggestions for further research and managerial implications.

2. The need for a ramp handling PMS

Although it has been put forward that a PMS is required, it remains unclear how ramp handling service business units can adapt and implement such a system to improve their efficiency. As ramp handling encompasses the activities of loading and unloading aeroplanes as well as the transport of passengers, crew, baggage, freight and mail between aeroplanes and terminal buildings, it can be classified as a logistics service. This service is provided by a third party ground handler, the airline (self handling) or by the ramp handling business unit of an airport (Fuhr and Beckers, 2006). In this study, we focus on airports in their role as (integrated) ramp handlers.

Today's airport performance measurement approaches mainly deal with the airport as a whole organization (Francis et al., 2002), not with ramp handling business units in particular. In the context of airports, a large number of studies have been conducted with focus on financial, qualitative, political or ecological perspectives, whereby most research concentrated on financial performance indicators (Abbott and Wu, 2002; Doganis et al., 1995; Gillen and Lall, 1997; Martin and Roman, 2001; Murillo-Melchor, 1999; Parker, 1999; Sarkis, 2000) or quality-based performance measures (Adler and Berechman, 2001; Ashford et al., 1995; Hegendorfer and Morris, 2000; Hegendorfer and Tyler, 1999; Tyler, 2000; Yeh and Kuo, 2003). Some authors follow a combination of economic and quality driven perspectives (ATRS, 2003; Pels et al., 2003; TRL, 2003).

However, the most contemporary subject of investigation concerns liberalization and deregulation of the airport market (Civil Aviation Authority, 2000; Templin, 2005) as well as the analysis of ecological influences of airports, such as noise or exhaust emissions (Graham and Guyer, 1999; Upham and Mills, 2005). From this we can see that there is no fully developed PMS available, which could be applied to the context of ramp handling. Therefore, the following section will provide the necessary conceptual background on PMSs.

3. Conceptual background

The topic of performance measurement is often discussed but rarely defined (Neely et al., 1996). Performance can be seen in various ways, but there is a consensus that when evaluating performance, and also especially logistics performance, it can generally be distinguished between effectiveness and efficiency (Glaeson and Barnum, 1986; Neely et al., 1996; Rafele, 2004). Effectiveness refers to the extent to which customer requirements are met, whereas efficiency is a measure of how economically the firm's resources are utilized when providing a given level of customer

satisfaction (Mentzer and Konrad, 1991; Neely et al., 1996). Therefore, the main purpose of performance measurement is to evaluate effectiveness and efficiency (Lai et al., 2004) and to support a firm's decision-making by delivering reliable information about the performance (Ukko et al., 2007). For this reason, a set of performance measures, so-called metrics, are arranged in a PMS to quantify the effectiveness and efficiency of the firm's actions (Neely et al., 1996).

To provide an overview of the holistic performance measurement interpretation within this article, Fig. 1 shows a three-phase performance measurement framework with design, measurement and implementation phases (taking into account a framework by Bredrup, 1995).

3.1. The design phase

The chosen performance indicators should add up to a valid, robust and integrative system and not only be a disparate assortment of individual metrics (Caplice and Sheffi, 1994; Rafele, 2004). Financial performance, for example, only reflects the outcome, not the process of achieving this outcome (Hafeez et al., 2002). Too much a focus on financial or cost-oriented systems can be seen as insufficient for managing a logistics service provider, because it would neglect the analysis of the process dimension, vital to successful logistics (Wegelius-Lehtonen, 2001) and logistics service providers, respectively.

In usual approaches, logistics performance is seen as a subset of firm or organizational performance (Chow et al., 1994). Nevertheless, this does not directly apply to the logistics performance of logistics service providers (such as ramp handling organizations studied here), since logistics services can be regarded as the primary function of these organizations. Accordingly, for these organizations there is an even stronger linkage of logistics efficiency and organizational effectiveness, which should be reflected in the PMS.

The activity of ramp handling further holds typical characteristics of a service. The service cannot be stored and the customers (such as airlines) or the customers' goods (such as freight) need to be integrated into the service process. In the literature this is referred to as perishability and the integration of an external factor (the customer), since production and consumption of services occur simultaneously (Hill, 1999; Zeithaml et al., 1985). Therefore, when designing a PMS for ramp handling, these characteristics need to be taken into account.

Based on this background, there is a definite need for more process- and value chain-oriented performance measurement approaches (Leyk and Kopp, 2004; Schwolgin, 2004; Wahler and Cox, 1994), which take the strategically most important processes into account and establish a connection to the company's effectiveness. Therefore, the here presented PMS framework for ramp handling contains performance measures structured along the basic logistics value chain with its individual dimensions: Input, process, output and outcome (Brown, 1996). Due to the service characteristics of ramp handling (Hill, 1999; Zeithaml et al., 1985) process and output can be seen as closely connected (Ballé, 1995; Stainer, 1997). The dimensions input and process/output

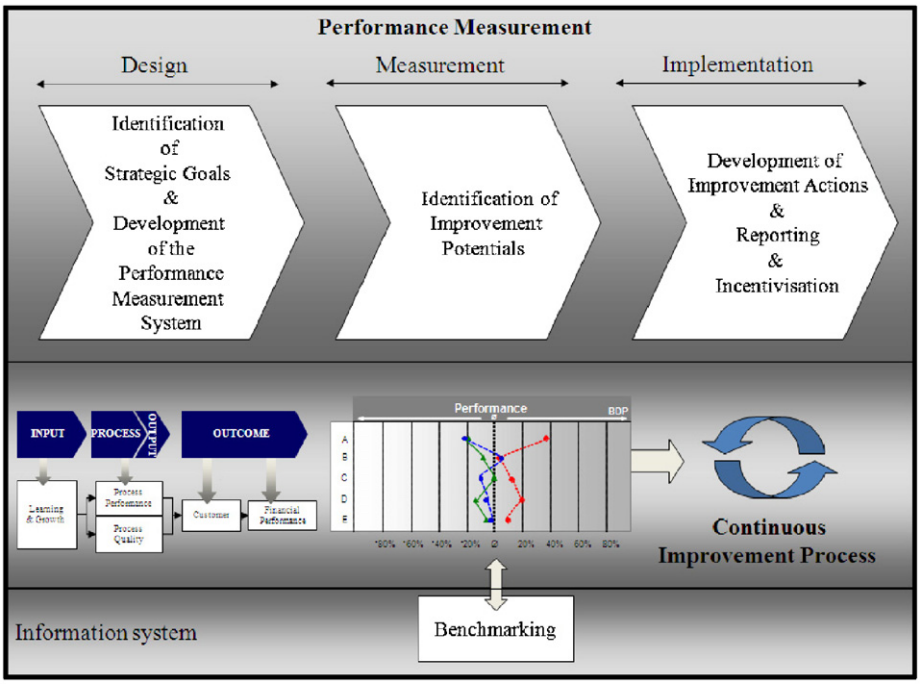

Fig. 1.

rather represent the efficiency, whereas the outcome dimension rather describes the effectiveness of the ramp handling organization.

To achieve the objective of structuring the PMS further along the logistics value chain, already established concepts were used. There are several accepted frameworks for PMSs available in the literature (Schmitz and Platts, 2004; Smith and Smith, 2007). One of the reasons for choosing the Balanced Scorecard (BSC) was that Kaplan and Norton (1992) indicated and asked for the single performance indicators used in the BSC to reflect the internal value chain of an organization with their cause-and-effect relationships. The BSC further offers a multi-dimensional view of the measured performance and allows considering financial and non-financial measures related to the critical success factors of the firm (Sandström and Toivanen, 2002, p. 82), as well as past- and future-oriented performance indicators.

The BSC uses four perspectives, the customer, internal business process, learning and growth as well as financial perspective (Kaplan and Norton, 1992, 1996d). In order to meet the explicit demand for a PMS that reflects the logistics value chain, the system used in this work connects the perspectives of the BSC according to their cause-and-effect relationships and assigns them to the described value chain dimensions.

The learning and growth perspective focuses on the input and represents the firm's employees and infrastructure, which keep the key processes running. Here, this perspective also encompasses the interface with suppliers (who perform certain necessary actions in advance).

The internal business process perspective concentrates on the transformation process, respectively, process/output and can help to identify actions needed to achieve a desirable outcome for the customer and the firm. The customer perspective as well as the financial perspective then concentrate on these outcomes (Ukko et al., 2007).

This combination of the BSC perspectives and the service value chain dimensions is depicted (as the arrows from input to outcome) in Fig. 1, the design phase. This structure for the ramp handling PMS also fulfills the scientific demand for more process orientation in airport research (Francis et al., 2002, 2003; Neely et al., 2000).

For the detailed development of the ramp handling PMS within the design phase, this article follows the procedural method of Kaplan and Norton (1992, 1996d). Thereby, the core idea is the transformation of the corporate or business unit vision and strategy into quantitative and qualitative goals and measures (e.g. Kaplan and Norton, 1996a, c), which should be transparent and understandable for everyone. The BSC should be understood as the dials and indicators in an aeroplane cockpit, allowing managers to have access to complex information at a glance (Kaplan and Norton, 1992).

The following proceeding (according to Kaplan and Norton, 1992) describes the steps taken in the empirical part:

(1) The corporate or business unit strategy is explicitly defined;
(2) The strategic sub-goals for each BSC Perspective are identified;
(3) The sub-goals are translated into performance measures and assigned to the dimensions along the logistics value chain.

The first step serves to identify strategic priorities of individual organizations, and the usage of interviews or workshops has been suggested (Bourne et al., 2000; Kaplan and Norton, 1993). The next step consists in breaking down the corporate strategy into sub-goals for every BSC perspective. Afterwards, in the third step, the results are further operationalized into single performance measures (Kaplan and Norton, 1992, 1996d, 2001). Thereby, the BSC helps to link operational measures to corporate strategy (Kaplan and Norton, 1993, 2001) and the cause-and-effect linkages further describe the hypotheses of the strategy (Kaplan and Norton, 1996b, 2001).

In the empirical part of this article, all individual measures are weighted and then assigned to the dimensions input, process/output and outcome. This is done in order to meet the demand for a more value or process-oriented PMS, explained earlier.

3.2. The measurement and implementation phases

During the second phase of the overall performance measurement framework, the measurement phase, the developed PMS is applied in a benchmarking study. Thereby, the second research objective of this article is addressed, i.e. to identify possible room for improvement at EU hub airports. The reason for integrating the results of a performance measurement into a benchmarking study is that the usage of a PMS alone cannot give sufficient information about the company's relative competitive performance (Neely et al., 1995). Therefore, benchmarking can be regarded as an essential part of performance measurement (Lawson, 1995).

The results of the benchmarking study are then used in the third phase of the performance measurement framework, the implementation phase. Based on the identified performance gaps, respective recommendations can be developed. Interviews with experts of the participating hub airports were performed one year after completion of the study to determine the applicability of the developed PMS.

4. Research design: action research

The literature review highlighted a lack of specific PMSs for ramp handling and the novelty of our research question for this field. According to Yin (2003), qualitative research methods should be used to answer "how", "why" and open questions (Burrell and Morgan, 1985; Silverman, 2004; Yin, 2003). Furthermore, it is also a method, which helps to address research objectives within a natural setting, which would otherwise be expensive, difficult, or impossible to replicate in a laboratory experiment, and also difficult to be expressed by statistical or regression

models (Hales and Chakravorty, 2006). In these regards, logistics research was pointed out as requiring more action research-driven approaches (Dunn et al., 1993; Mentzer and Kahn, 1995) to cover all relevant perspectives on the investigated research objectives and to generate added value by capturing real-world problems (Alvesson, 1996). Action Research allows researchers to "[…] spend time in organizations and research logistics in action. Only by being out in the 'real world' can we gather first-hand information to develop knowledge and gain extreme relevance […]" (Näslund, 2002, p. 328). Therefore, the researchers are professionally involved with the concerned industries (Hameria and Paatela, 2005). Action research moreover supports the creation of a new system as it is the case with the development of a PMS. For these reasons it was considered appropriate to approach our topic with action research.

The action research for this article was conducted by the members of a core research team together with EU hub airports. To guarantee data comparability between the airports, only hub airports within the EU were targeted for data gathering on their ramp handling. We focused on forward integrated airports (Fuhr, 2006), and so ramp handling represents one of their primary functions. Three of six potential hub airports within the EU could be obtained for participation within this research project. In the following these three airports will be referred to as airports A, B and C. In line with Smith and Smith (2007), we take on the view that these can be regarded as "action research case studies", and will refer to them as "cases" in the remainder of this article (also similarly done by Yee et al., 2006).

Based on the action research model of Checkland (1985) and Checkland and Holwell (1998), the research design for the development of the PMS was developed. Action research is characterized by its collaborative and cyclical nature which is reflected in the current literature as a recurring cycle of planning, acting, observing and reflecting (Altrichter et al., 2002; Kyrö, 2004; Zuber-Skerritt, 2001). Building on Kaplan and Norton (1993) and Neely et al. (2000) show an idealized proceeding for the development of a PMS, which is characterized by expert interviews and workshops. This multi-stage adjustment process has been found to lead to a successful development and implementation (Neely et al., 2000) and was therefore also applied here. Bourne et al. (2000) suggest, in accordance to Schein (1969), the involvement of a process consultant, who acts as a coordinator of this process. Therefore, the researcher shifts from his or her role as an observer to an active participant within the research themes or topics (Näslund, 2002; Smith and Smith, 2007). Most of the time she or he is taking part inside organizations and occasionally moving out of the system to view it from a distance (Ottosson, 2003).

In this study this was implemented by having at least two members of the research team gather data and accompany the firm throughout the PMS design process over a period of 12 months. In accordance with Yee et al. (2006) the action research process was structured along several main phases. The data throughout these phases were gathered through workshops, company documents, interviews and field notes made during co-location. The interviews were conducted by at least two researchers, transcribed and cross-reviewed. In each interview, one researcher was leading the interview, whereas the other one was mainly present to observe and provide a second account of the interview content. This process was implemented in order to ensure that loss of information and meaning would be kept at a minimum. Regarding the co-location, the members of the research team were actually spending 2–3 days per week on site. This reflects the four common methods to gather data mentioned in action research literature: observation, literature analysis, interviews and expert workshops (Silverman, 1993). In line with the prior research described (Bourne et al., 2000; Neely et al., 2000; Rozemeijer, 2000), a multi-step research design was chosen, depicted in Fig. 2.

The research was conducted iteratively regarding the overall phases, but with parts going on in parallel. After the first expert workshop, in which all the hub airports participated, site visits and document analysis were conducted with all cases in parallel. In total, 17 workshops were held: One workshop with all three cases to define the overall strategy and goals, three workshops with the individual airports to define their sub-strategies, 12 workshops (four each) regarding the four sub-topics. The results of these individual data collection efforts were then fed into an aggregated workshop (final workshop) with all three cases, where all hub airports participated simultaneously and jointly discussed.

Table 2 summarizes the main aspects of the workshop and interview design.

The workshop participants on part of the hub airports were experts, comprising managers and specialists. The specialists came from backgrounds with specific knowledge regarding the perspectives of the BSC, i.e. from human resources, controlling, quality management, process management, as well as corporate and business unit strategy. After each workshop, brief descriptive summaries were made and peer reviewed. This was done in order to help reduce researcher bias in the analytical process (Smith and Smith, 2007). For every airport a minimum of five specialists plus a manager took part. The researchers acted as observers and process consultants, in accordance with Bourne et al. (2000).

The research process as illustrated in Fig. 2 enabled the collection of very detailed data and gaining in-depth insights. At the same time it allowed for varying degrees of distance from the context studied and specific periods of increased reflection when away from the client site.

The data for performing the relative performance analyses among the cases (summarized in Table 3 later on) was average 2004 data provided by the airports. Although only reflecting one year, we regard the assessment reliable for identifying basic differences among the cases. The benchmarking with help of the developed system was meant to initiate an ongoing measurement process for years to come, which would be interesting to follow up also from a research perspective.

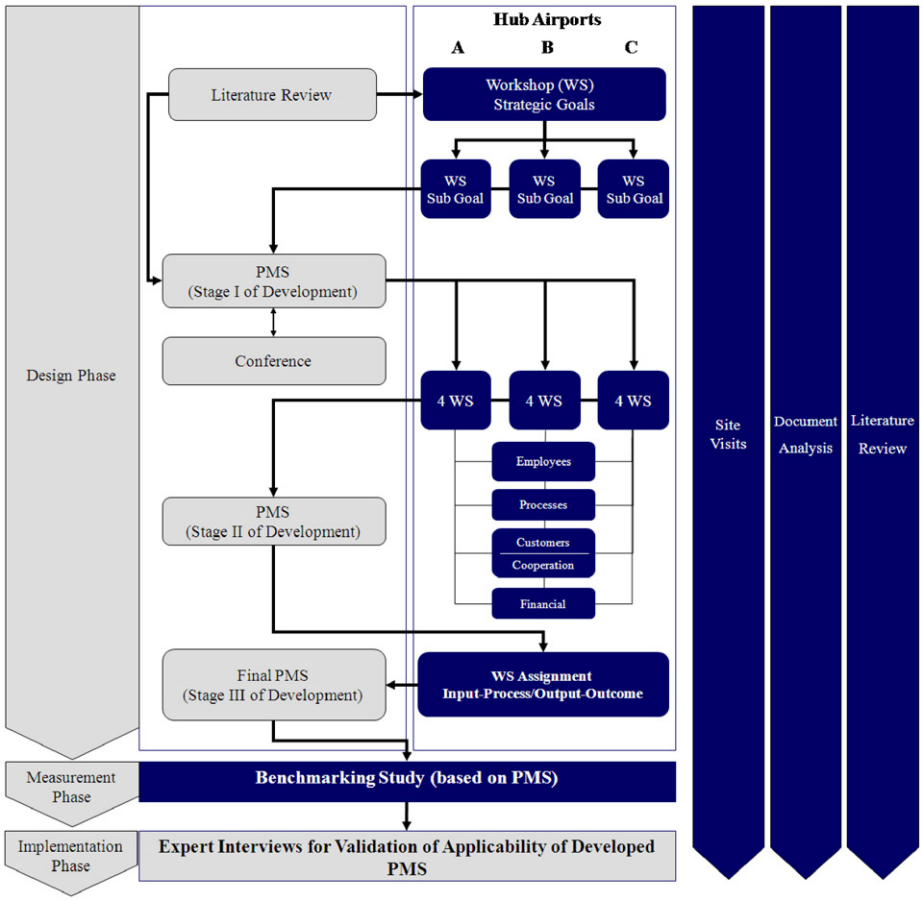

Fig. 2.

5. Development of the ramp handling PMS

The ramp handling PMS was developed in several steps, as explained in the conceptual background section. According to the action research method outlined in the previous section, expert workshops, site visits, document analysis as well as the literature review were all feeding into the development. In this process researchers worked with each hub airport for itself, but with the shared goal to come up with a single BSC for all participating airports.

5.1. Definition of corporate or business unit strategy

In order to gain insights into how to link the performance measures to corporate and business unit strategy (Kaplan and Norton, 1996a, c) for the hub airports, the first expert workshop addressed management representatives, who discussed the major strategic objectives for the ground handling business. During this discussion, increasing cost pressure on logistic services at airports as well as the need to become more market-oriented and customer-driven emerged as the most important issues. In accordance to business unit strategy and in order to maintain or to achieve market leader status, two strategic business unit aims were identified: (1) increasing the ramp handling business' profitability; and (2) improving customer orientation by increasing process quality.

5.2. Identification of strategic sub-goals per BSC perspective

In line with the general purpose of the BSC (Kaplan and Norton, 1996a) the second round of workshops aimed at breaking down the company's strategy into sub-goals. A summary of the results is shown in Fig. 3.

Therefore, the participants, experts from controlling, quality, human resources and the operations management department, were asked to discuss the main drivers, elementary for achieving the strategic goals defined in the first workshop. Then, sub-goals for every BSC perspective were defined, i.e. the customer, internal business process, growth and learning, and financial perspective. Afterwards, as part of the critical reflection, a first draft of the PMS based on the findings made in the first two rounds of workshops was presented and discussed at a European conference dealing with the topic of airport benchmarking.

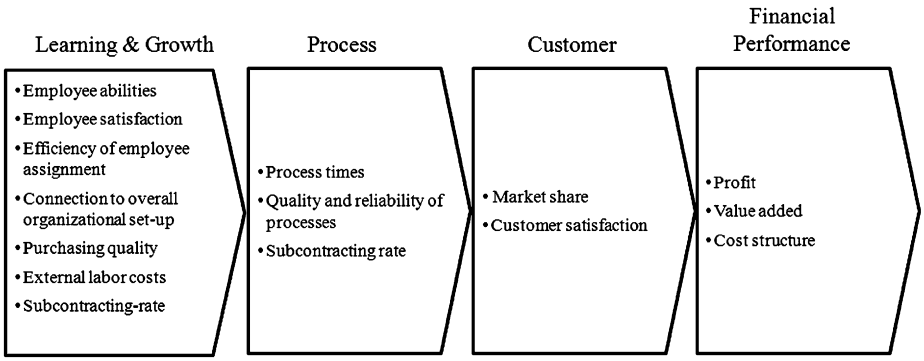

Fig. 3.

5.3. Translation of sub-goals into performance measures with subsequent assignment and weighting along the logistic value chain dimensions

After the PMS was updated based on the feedback from the workshops and conference, it was presented in the third round of workshops and was used as a basis for further discussions.

The "workshop" in this phase indeed consisted of several sub-workshops at each airport, each sub-workshop concentrating on one of the four perspectives. The participants were asked to add additional performance indicators, which they considered as relevant. Afterwards, all performance indicators were evaluated according to the characteristics of measurability and relevance, according to Durst and Binder (2006). Only performance measures with a high relevance and a high measurability were selected in order to meet the request for low complexity. Using this information, the researchers were able to develop the holistic PMS.

The aim of the workshops within the last phase was to evaluate the cause-and-effect relationships of the single performance indicators. These workshops were conducted together with experts from all benchmarking partners (Table 1). Further, all relevant performance measures were linked to the performance dimensions input, process/output and outcome as well as to their determined relative weightings in the analytic hierarchy process (AHP) approach (Korpela et al., 2001). An overview of the final reference PMS for the ramp service business is presented in Fig. 4 (the abbreviations are explained in Table 2).

Before it was used in the benchmarking study, the final PMS was provided to all participants for peer review. This approach is in line with Fahrni et al. (2002), who explicitly recommend a multi-phase adjustment for all performance measures with all benchmarking partners in the context of competitive benchmarking.

Table 1
Research design.

Target organizations	Ramp handling organizations of forward integrated EU hub airports
Interviewees and workshop participants	Experts and managers from controlling, human resources, quality management, process management, corporate and business unit strategy for each of the hub airports A, B and C
Selection criteria (experts and managers)	• Minimum 5 years of experience in ground handling business or 10 years in airport business • Minimum 5 years in company
Structure of workshops	• Structured according to the performance measurement dimensions • Duration: 1–2 days (several data analyses and site visits were performed for each hub airport in advance of the workshops)

6. Identification of performance gaps as a result of the measurement phase

After developing the final PMS, a benchmarking was performed using this system. Herein, the jointly developed measurement system was applied to all cases. The aim of this was to identify the biggest performance gaps among the EU hub airports and to guarantee a "[…] process of improving performance by continuously identifying, understanding, and adapting outstanding practices and processes found inside and outside the organization and implementing the results" (Jarrar and Zairi, 2001, p. 901). The general critique of lacking comparability of benchmarking objects (Humphreys and Francis, 2000a, b), especially because of differing processes and organizational structures, was taken into account by identifying processes strategically relevant to all participating hub airports. Those processes were unloading (including aircraft acceptance), baggage transport and loading (including aircraft clearance). Furthermore, because of the differences in handling different aeroplane types, the analyzed aeroplane types were clustered into wide-body, narrow-body and regional jets in the benchmarking study.

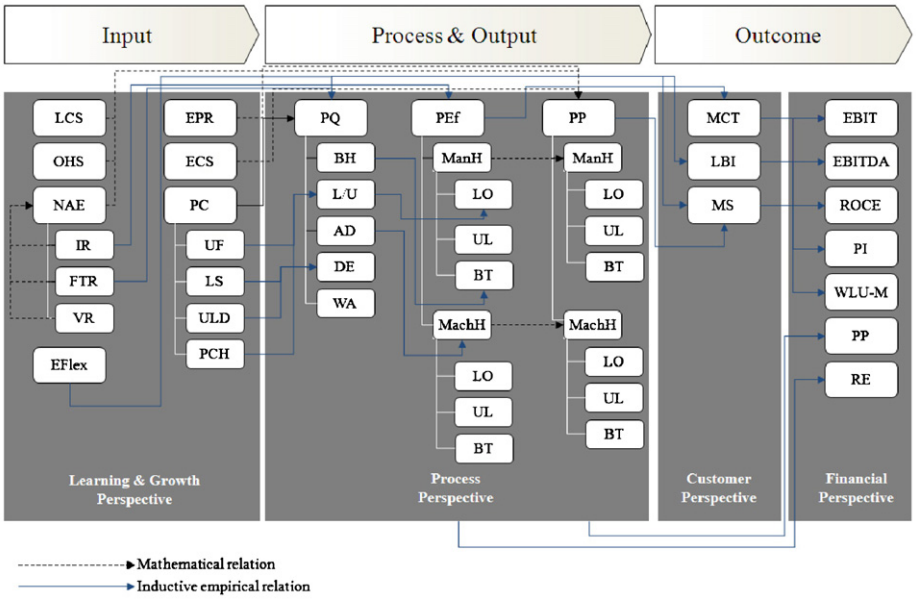

Fig. 4.

Table 2
Legend of abbreviations to Fig. 4.

Learning and growth perspective		Process perspective			Customer perspective	Financial perspective
LCS = labor cost structure	EPR = external personnel rate	PQ = process quality	PE = process efficiency	PP = product productiveness	MCT = minimum connection time	EBIT = earnings before interest and taxes
OHS = overhead structure	ECS = external cost structure	BH = baggage handling	ManH = man hours		LBI = left behind index	EBITDA = EBIT depreciation and amortization
NAE = net availability of employees	PC = purchasing quality	L/U = loading/ unloading	LO = loading		MS = market share	ROCE = return on capital employed
IR = incidence rate	UF = unpunctual flight	AD = aircraft damage	UL = unloading			PI = personnel intensity
FTR = further training rate	LS = loading system	DE = defective equipment	BT = baggage transport			WLU-M = work load units-margin
VR = vacation rate	ULD = unit load device	WA = workplace accidents	MachH = machine hours			PP = personnel productivity
EFlex = employee flexibility	PCH = position change					RE = resource efficiency

This selection was based on the following criteria. First, these were the same or equivalent types handled by all cases. Second, they experienced a similar turnover. The measurement was performed for all measures shown in Fig. 4, and the main gaps identified are shown in Table 3. These gaps concern labor costs, overhead structures, net-availability of employees, procurement quality and process quality.

The gaps shown here are the ones exceeding a 20 percent deviation from the average and were those deemed most important by the benchmarking participants. These findings are also further discussed in the managerial implications section.

None of the cases showed best demonstrated practice (bdp) regarding all dimensions and measures. An interesting aspect observable was that the hub airports tended to be best performing regarding costs or quality. As such the overhead structure took a prominent position as one important aspect of major deviation between the participants. It reflects how lean the organizational set-up of the cases can be considered. The best performer in these regards had 70 percent less overhead costs than the average, whereas the worst performer had 90 percent more. Another revelation regarding the process perspective concerned the delays due to baggage handling and loading process, as well as handling equipment malfunctions. The processes were analyzed based on a common standard, according to the standard process steps within the AHM (Aircraft Handling Manual), ensuring comparability.

Regarding the first, the best performer had 40 percent less incidents, whereas the worst had 80 percent more.

Table 3

Category	Definition	Best performer[a] (%)	Worst performer[a] (%)
Labor costs	$\frac{\text{Labor costs (excluding overhead)}}{\text{Number of FTEs}}$	−15	20
Overhead	$\frac{\text{Overhead costs}}{\text{Number of FTEs}}$	−70	90
Net availability of employees	$\frac{\text{Average shift length} * 365 \text{ days}}{\text{Net hours/FTE}}$	40	−25
Procurement quality			
Damage rate of ULDs (unit load devices)	$\frac{\Sigma \text{ damaged ULDs}}{\Sigma \text{ handlings}}$	−25	35
Number of changes in aircraft position	$\frac{\Sigma \text{ airgraft position changes}}{\Sigma \text{ handlings}}$	−40	60
Process quality			
Delays due to baggage handling and loading processes	Total number (min)	−40	80
Delays due to handling equipment malfunctions	Total number (min)	−40	60

[a] As percentage deviation from average.

Regarding the latter, the best performer experienced 40 percent less delays than average, whereas the worst performer had 60 percent more delays. Concerning the learning and growth perspective, the analysis of the net availability of employees was considered particularly revealing by the participants. The analysis showed that the gap between the gross and net working hours of employees was particularly driven by sick days. The nature of the ramp handling business was moreover driving the organizations to ensure availability of employees for peak times during the day, aggravating the net availability difference.

6.1. *Ex-post validation of the developed PMS*

One year after completion of the benchmarking study, the participating airports were asked how the developed PMS had been contributing to changes and improvements at the participating airports and their ramp handling divisions. This directly corresponds with the idea of action research to observe real-world reactions to induced interventions.

On the basis of expert interviews it was analyzed whether the jointly developed system had initiated radical changes and/or continuous improvement processes across the cases (Andersen, 1995; Hinton et al., 2000; Zairi, 1994). In summary, the expert interviews revealed that both processes of continuous change (particularly airport A) as well as radical change (particularly airport B) had been induced. The exact results can be seen in Table 4.

These changes are highlighting the benefits achieved by the implementation and usage of the developed PMS for the participating airports. Looking at these changes, the positive results can be interpreted as a first validation of the developed PMS (Miles and Huberman, 1994; Rozemeijer, 2000; Ulrich, 1982). Particularly, the applicability of the logistics service chain-oriented system in the individual dimensions of input, process/output and outcome was explicitly valued by the airports as "[…] a continuous, stringent system for evaluating performance […]" (Airport A).

7. Summary and conclusions

Noting the growing relevance of this topic in practice, and addressing a general research gap in airport logistics, we set out with the objectives of developing and applying a PMS for ramp handling businesses.

Based on a conceptual model of a phase-based framework of performance measurement, action research was conducted together with EU hub airports in order to determine how a PMS should be designed to ensure a holistic basis for benchmarking ramp services (summarized in Fig. 1). This PMS combines BSC-derived perspectives with process-oriented dimensions, adapting it to the context of logistics services.

One of the goals of the airports performing the benchmarking activities was to increase competitiveness. While it could be argued that participating in such a study potentially erodes their competitive advantages due to complete transparency of their individual strengths and weaknesses, this was actually not a major issue here. A reason for this is especially seen in the fact that all of them are facing increasing competition by new market entrants, which was perceived a much more major threat than sharing information with the other participants of the benchmarking.

Table 4

	Processes of continuous change	Processes of radial change
Hub airport A	• Additional workshops for discussing room for improvement have been planned • Results have been integrated into continuous change process • Results have been used for subsequent projects	• Results have been used as input for strategic decisions
Hub airport B	• First, incremental changes have been initiated	• Introduction of new process segmentation • Radical changes have been initiated, which led to quality improvements • Thoughts about reorganization of the ground handling division have emerged
Hub airport C	• Results have been integrated in Continuous Improvement Program (CIP) • Additional workshops have been initiated to discuss results	• Rethinking of process segmentation • Implementation of new quality standards

7.1. Limitations and further research

One weakness of the study is its generalizability. Nevertheless, since the three action cases were drawn from the full forward integrated EU hub airport sample of six, the generalizability to these may be relatively good, especially as they operate in a similar legal environment. With regard to the European context, the particular situation of recent liberalization of some of the airport processes has created a rather special environment. An interesting aspect for further research here is therefore to observe how the EU directive will be adapted in the future, because parts of the airport infrastructure still show monopolistic characteristics. For generalizing to hub airports beyond the EU, the legal context differences have to be analyzed carefully.

The findings generated are specific for the context of hub airports and their special requirements, but the basic model of the PMS should be easily transferable to O&D (Origin & Destination) ground handling processes. Since O&D airports represent the main share of existing airports and competitive pressures for optimizing these processes are high for them either, we deem further empirical research valuable for getting more general insights, and extending the insights for other airport types.

Further investigations would enrich the knowledge of the scientific community on airport logistics. Concerning methodology, related investigations with in-depth case studies in this field are advisable. Further validation of the PMS for ramp services could be achieved by implementing the system in other real-world settings. Apart from qualitative approaches, future studies could also quantitatively investigate the cause-and-effect relationships developed in the presented system. A regression analysis may be performed and stimulate findings based on a broader sample. Further, by regular replication of the benchmarking based on the developed PMS, findings of a more longitudinal nature could be generated.

Another point is that although the scope of vertical integration has been treated from the perspective of airlines to some extend (Fuhr, 2006; Fuhr and Beckers, 2006), a detailed scientific analysis of vertical integration specifically concerning ramp handling from the airports' perspective is still missing. Regarding the specific gaps identified in this study and the insights of the later validation of the system, it was observed that the cases started reconsidering the boundaries of their firms, and outsourcing became a topic of increased discussion at these airports. Nevertheless, this was just in its beginning and would be interesting for further research to follow up and see how this is further approached and eventually implemented.

7.2. Managerial implications

The presented model has proven potential for structuring relevant logistic service providers' performance dimensions and providing actionable results. During development of the system, its practical relevance was continuously ensured. Also, the ex post validation has shown that after using the PMS radical and continuous improvement processes have been induced. The insights gathered here are therefore considered potential input for all types of ramp handling process businesses—regardless of whether it is self-handling, airports services, or third party logistics providers who perform these activities.

Concerning the specific results of the benchmarking, the performance analysis showed that the greatest disparities between the EU hub airports concerned the net availability of employees (mainly as a result of a high number of sick days), personnel structure, overhead structure, performance quality and process quality.

Regarding the overall practical implications of these benchmarking results, outsourcing was discussed by the cases studied here. This is also in line with previous outsourcing research, which suggests that outsourcing can help increasing cost efficiency, gathering new knowledge for process optimization, reducing overheads, increasing flexibility of employee deployment as well as improving process quality (Fan, 2000; Kakabadse and Kakabadse, 2002; Quinn and Hilmer, 1994; Willcocks et al., 1995).

However, to decide on the make-or-buy question, a more detailed focus on capabilities and the core competencies of the individual airport have to be considered in addition (McIvor, 2003; McIvor et al., 1997).

Taking into account that these rather fundamental considerations were a result of performing the benchmarking, some concluding notions should be made. First, in order to achieve detailed results as a basis for further actions, a thorough picture of performance in the setting of logistics clearly involved a process-oriented perspective. Second, the cases here demonstrated that no company is an island, and that it appears wisely to form a benchmarking network, even with potential competitors, and identify weaknesses jointly, standing shoulder to shoulder against a common threat.

References

Abbott, M., Wu, S., 2002. Total factor productivity and efficiency of Australian airports. The Australian Economic Review 35 (3), 244–260.

Adler, N., Berechman, J., 2001. Measuring airport quality from the airlines' viewpoint: An application of data envelopment analysis. Transport Policy 8, 171–181.

Air Transport Association, 2006. ATA Economic Report 2006. Air Transport Association of America, Washington, DC.

Albers, S., Koch, B., Ruff, C., 2005. Strategic alliances between airlines and airports. Journal of Air Transport Management 11 (2), 49–58.

Altrichter, H., Kemmis, S., McTaggart, R., Zuber-Skerritt, O., 2002. The concept of action research. The Learning Organization 9 (3), 125–131.

Alvesson, M., 1996. Leadership studies: From procedure and abstraction to reflexity and situation. Leadership Quarterly 7 (4), 455–485.

Andersen, B., 1995. Benchmarking. In: Rolstadas, A. (Ed.), Performance Management: A Business Process Benchmarking Approach. Chapman & Hall, London.

Ashford, N., Stanton, M., Moore, C., 1995. Airport Operations. Wiley, New York.

ATRS, 2003. Airport Benchmarking Report. Air Transport Research Society, University of British Columbia, Vancouver.

Ballé, M., 1995. The Business Process Re-engineering Action Kit. Kogan Page, London.

Bernabai, C., 2001. Airports: An integral part of the air traffic management system. Air and Space Europe 3 (1/2), 25–27.

Bourne, M., Mills, J., Wilcox, M., Neely, A., Platts, K., 2000. Designing, implementing and updating performance measurement systems. International Journal of Operations and Production Management 20 (7), 754–771.

Bredrup, H., 1995. Background for performance management. In: Rolstadas, A. (Ed.), Performance Management: A Business Process Benchmarking Approach. Chapman & Hall, London, pp. 61–87.

Brown, M., 1996. Keeping Score: Using the Right Metrics to Drive World Class Performance. Productivity Press, New York.

Burrell, G., Morgan, G., 1985. Sociological paradigms and organisational analysis: Elements of the sociology of corporate life. The International Journal of Logistics Management 8 (1), 1–14.

Caplice, C., Sheffi, Y., 1994. A review and evaluation of logistics metrics. The International Journal of Logistics Management 5 (2), 11–28.

Chan, F., Chan, H., Lau, H., Ip, R., 2006. An AHP approach in benchmarking logistics performance of postal industry. Benchmarking: An International Journal 13 (6), 636–661.

Checkland, P., 1985. Systems Thinking, Systems Practices. Wiley, Chichester.

Checkland, P., Holwell, S., 1998. Information, Systems and Information Systems: Making Sense of the Field. Wiley, Chichester.

Chow, G., Heaver, T., Henriksson, L., 1994. Logistics performance: Definition and measurement systems. International Journal of Physical Distribution and Logistics Management 24 (1), 17–28.

Civil Aviation Authority, 2000. The use of benchmarking in airport reviews. Civil Aviation Authority, London.

Doganis, R., 2001. The Airline Business in the Twenty-First Century. Routledge, London.

Doganis, R., 2002. Flying off Course: The Economics of International Airlines. Routledge, London.

Doganis, R., Graham, A., Lobbenberg, A., 1995. The economic performance of European airports (No. 3). Department of Air Transport Research, Cranfield University, Bedford, UK.

Dunn, S., Seaker, R., Stenger, A., Young, R., 1993. An assessment of logistics research paradigms. Working Paper, The Pennsylvania State University, State College, Pennsylvania.

Durst, S., Binder, M., 2006. Improving efficiency through internal benchmarking. International Journal of Business Performance Management 8 (4), 290–306.

European Commission, 2003. Ground handling market at community airports (revision on the directive 96/67/EC). Retrieved 05.04.2008 from 〈http://ec.europa.eu/transport/air_portal/consultation/2003_06_01_en.htm〉.

Fahrni, F., Völker, R., Bodmer, C., 2002. Erfolgreiches Benchmarking in Forschung und Entwicklung, Beschaffung und Logistik. Hanser, München.

Fan, Y., 2000. Strategic outsourcing: Evidence from British companies. Marketing Intelligence and Planning 18 (4), 213–219.

Francis, G., Humphreys, I., Fry, J., 2002. The benchmarking of airport performance. Journal of Air Transport Management 8 (4), 239–247.

Francis, G., Humphreys, I., Fry, J., 2003. An international survey of the nature and prevalence of quality management systems in airports. TQM and Business Excellence 14 (7), 819–829.

Francis, G., Humphreys, I., Fry, J., 2005. The nature and prevalence of the use of performance measurement techniques by airlines. Journal of Air Transport Management 11 (4), 207–217.

Fuhr, J., 2006. (De)regulation of European ramp handling market: Lessons to be learned from an institutional perspective? Working Paper, Center for Network Industries and Infrastructure CNI, Berlin.

Fuhr, J., Beckers, T., 2006. Vertical governance between airlines and airports: A transaction cost analysis. Review of Network Economics 5 (4), 386–412.

Garvens, M., 2005. The airport of the future against backdrop of dramatic changes in the aviation sector. In: Delfmann, W., Baum, H., Auerbach, S., Albers, S. (Eds.), Strategic Management in the Aviation Industry. Ashgate, Aldershot.

Gillen, D., Lall, A., 1997. Developing measures of airport productivity and performance: An application of data envelopment analysis. Paper presented at the Aviation Transport Research Group Conference, Vancouver.

Glaeson, J., Barnum, D., 1986. Toward valid measures of public sector productivity: Performance measures in urban transit. Management Science 28 (4), 379–386.

Gonnord, C., Lawson, F., 2000. Airports: A precious resource of the aviation network. Air and Space Europe 2 (5), 33–39.

Graham, B., Guyer, C., 1999. Environmental sustainability, airport capacity and European air transport liberalization: Irreconcilable goals? Journal of Transport Geography 7, 165–180.

Gregory, M.J., 1993. Integrated performance measurement: A review of current practice and emerging trends. International Journal of Production Economics 30–31, 281–296.

Hafeez, K., Zhang, Y., Malak, N., 2002. Determining key capabilities of a firm using analytic hierarchy process. International Journal of Production Economics 76, 39–51.

Hales, D., Chakravorty, S., 2006. Implementation of Deming's style of quality management: An action research study in a plastics company. International Journal of Production Economics 103, 131–148.

Hameria, A.-P., Paatela, A., 2005. Supply network dynamics as a source of new business. International Journal of Production Economics 98, 41–55.

Hegendorfer, H., Morris, P., 2000. Competition hots up for top airport ratings. Airport World 5 (3), 26–29.

Hegendorfer, H., Tyler, C., 1999. Who's top in passenger satisfaction. Airport World 4 (3), 39–41.

Hill, P., 1999. Tangibles, intangibles and services: A new taxonomy for the classification of output. Canadian Journal of Economics 32 (2), 426–446.

Hinton, M., Francis, G., Holloway, J., 2000. Best practice benchmarking in the UK. Benchmarking: An International Journal 7 (1), 52–61.

Humphreys, I., Francis, G., 2000a. A critical perspective on traditional airport performance indicators. Paper presented at the 79th Annual Transportation Research Board Meeting, Washington, DC.

Humphreys, I., Francis, G., 2000b. The past present and future performance measurement of airports: The impact of changing ownership patterns. In: Neely, A. (Ed.), Performance Measurement

2000: Past, Present and Future. Cranfield School of Management, Bedford, pp. 251–258.
Jarrar, Y., Zairi, M., 2001. Future trends in benchmarking for competitive advantage: A global survey. Total Quality Management 12, 906–912.
Kakabadse, A., Kakabadse, N., 2002. Trends in outsourcing: Contrasting USA and Europe. European Management Journal 20 (2), 189–198.
Kaplan, R., Norton, D., 1992. The balanced scorecard: Measures that drive performance. Harvard Business Review 70 (1), 71–79.
Kaplan, R., Norton, D., 1993. Putting the balanced scorecard to work. Harvard Business Review 71 (5), 134–147.
Kaplan, R., Norton, D., 1996a. The Balanced Scorecard: Translating Strategy into Action. Harvard Business School Press, Boston, MA.
Kaplan, R., Norton, D., 1996b. Linking the balanced scorcard to strategy. California Management Review 39 (1), 53–79.
Kaplan, R., Norton, D., 1996c. Strategic learning and balanced scorecard. Strategy and Leadership 24 (5), 18–24.
Kaplan, R., Norton, D., 1996d. Using the balanced scorecard as a strategic management system. Harvard Business Review 74 (1), 75–85.
Kaplan, R., Norton, D., 2001. Transforming the balanced scorecard from performance measurement to strategic management: part I. Accounting Horizons 15 (1), 87–104.
Kennerley, M., Neely, A., 2002. A framework of the factors affecting the evolution of performance measurement systems. International Journal of Operations and Production Management 22 (11), 1222–1245.
Korpela, J., Lehmusvaara, A., Tuominem, M., 2001. An analytic approach to supply chain development. International Journal of Production Economics 71, 145–155.
Kyrö, P., 2004. Benchmarking as an action research process. Benchmarking: An International Journal 11 (1), 52–73.
Lai, K.-H., Ngai, E., Cheng, T., 2004. An empirical study of supply chain performance in transport logistics. International Journal of Production Economics (87), 312–331.
Lawson, P., 1995. Performance management: An overview. In: Walters, M. (Ed.), The Performance Management Handbook. Institute of Personnel & Development, London, pp. 1–13.
Leyk, J., Kopp, J., 2004. Unternehmensplanung bei Logistikdienstleistern mit Advanced Budgeting. In: Schneider, C. (Ed.), Controlling für Logistikdienstleister: Konzepte, Instrumente, Anwendungsbeispiele, Trends. Deutscher Verkehrsverlag, Hamburg, pp. 361–377.
Martin, J., Roman, C., 2001. An application of DEA to measure the efficiency of Spanish airports prior to privatization. Journal of Air Transport Management 7 (3), 149–157.
McIvor, R., 2003. Outsourcing: Insights from the telecommunications Industry. Supply Chain Management: An International Journal 8 (4), 380–394.
McIvor, R., Humphreys, P., McAleer, W., 1997. A strategic model for the formulation of an effective make or buy decision. Management Decision 35 (2), 169–178.
Mentzer, J., Kahn, K., 1995. A framework of logistics research. Journal of Business Logistics 6 (1), 231–250.
Mentzer, J., Konrad, B., 1991. An efficiency/effectiveness approach to logistics performance analysis. Journal of Business Logistics 12 (1), 33–61.
Miles, M., Huberman, A., 1994. Qualitative Data Analysis. Sage Publications, Thousand Oaks.
Müller, J., Kamp, V., Niemeier, H., 2005. Can we learn from benchmarking studies of airports and where do we want to go from here? Paper presented at the German Aviation Research Society Workshop on Benchmarking, Wien.
Murillo-Melchor, C., 1999. An analysis of technical efficiency and productivity changes in Spanish airports using the malmquist index. International Journal of Transport Economics 26 (2), 271–292.
Näslund, D., 2002. Logistics needs qualitative research: Especially action research. International Journal of Physical Distribution and Logistics Management 32 (5), 321–338.
Neely, A., Gregory, J., Platts, K., 1995. Performance measurement system design: A literature review and research agenda. International Journal of Operations and Production Management 15 (4), 80–116.
Neely, A., Mills, J., Platts, K., Gregory, M., Richards, H., 1996. Performance measurement design: Should process based approaches be adopted? International Journal of Production Economics 46–47, 423–431.
Neely, A., Mills, J., Platts, K., Huw, R., Gregory, M., Bourne, M., Kennerley, M., 2000. Performance measurement system design: Developing and testing a process-based approach. International Journal of Operations and Production Management 20 (10), 1119–1145.
Ottosson, S., 2003. Participation action research: A key to improved knowledge of management. Technovation 23 (2), 87–94.
Oum, T., Yu, C., Fu, X., 2003. A comparative analysis of productivity performance of the world's major airports: Summary report of the ATRS global airport benchmarking research report—2002. Journal of Air Transport Management 9 (5), 285–297.
Parker, D., 1999. The performance of BAA before and after privatization. Journal of Transport Economics and Policy 33, 133–145.
Pels, E., Nijkamp, P., Rietveld, P., 2003. Inefficiency and scale economics of European airport operations. Transportation Research Part E 39, 341–361.
Quinn, J., Hilmer, F., 1994. Strategic outsourcing. Sloan Management Review 35 (4), 43–55.
Rafele, C., 2004. Logistic service measurement: a reference framework. Journal of Manufacturing Technology Management 15 (3), 280–290.
Rozemeijer, F., 2000. Creating corporate advantage in purchasing. Unpublished Dissertation, Universiteits Drukkerij, Technische Universität Eindhoven, Eindhoven.
Sandström, J., Toivanen, J., 2002. The problem of managing product development engineers: Can the balanced scorecrad be an answer? International Journal of Production Economics 78, 79–90.
Sarkis, J., 2000. An analysis of the operational efficiency of major airports in the United States. Journal of Operations Management 18, 335–351.
SAS, 2005. The SAS Group's Annual Report and Sustainability Report. Scandinavian Airlines, Stockholm.
Schein, E., 1969. Process Consultation. Addison-Wesley, Reading, MA.
Schmitz, J., Platts, K., 2004. Supplier performance measurement: Indications from a study in the automotive industry. International Journal of Production Economics 89, 231–243.
Schwolgin, A., 2004. Stand und Entwicklungsperspektiven des Controllings von Logistikdienstleistern. In: Schneider, C. (Ed.), Controlling für Logistikdienstleister: Konzepte, Instrumente, Anwendungsbeispiele, Trends. Deutscher Verkehrsverlag, Hamburg, pp. 17–50.
SH&E, 2002. Study on the quality. London: SH&E.
Silverman, D., 1993. Interpreting Qualitative Data: Methods for Analysing Talk, Text, and Interaction. Sage Publications, London.
Silverman, D., 2004. Doing Qualitative Research, second ed. Sage Publications, Thousand Oaks.
Smith, M., Smith, D., 2007. Implementing strategically aligned performance measurement in small firms. International Journal of Production Economics 106, 393–408.
Soames, T., 1997. Ground handling liberalization. Journal of Air Transport Management 3 (2), 83–94.
Stainer, A., 1997. Logistics: A productivity and performance perspective. Supply Chain Management 2 (2), 53–62.
Templin, C., 2005. Deregulation of ground handling on six European airports. Paper presented at the German Aviation Research Society Workshop, Bremen.
TRL, 2003. Airport performance indicators. Research Report, Transport Research Laboratory, Wokingham.
Tyler, C., 2000. Pleasing the passenger. Airport World 5 (3), 19–22.
Ukko, J., Tenhunen, J., Rantanen, H., 2007. Performance measurement impacts on management and leadership: Perspectives of management and employees. International Journal of Production Economics 110, 39–51.
Ulrich, H., 1982. Anwendungsorientierte Wissenschaft. Die Unternehmung 36 (1), 1–10.
Upham, P., Mills, J., 2005. Environmental and operational sustainability of airports: Core indicators and stakeholder communication. Benchmarking: An International Journal 12 (2), 166–179.
Wahler, J., Cox, J., 1994. Competitive factors and performance measurement: Applying the theory of constraints to meet customer needs. International Journal of Production Economics 37, 229–240.
Wegelius-Lehtonen, T., 2001. Performance measurement in construction logistics. International Journal of Production Economics 69, 107–116.
Willcocks, L., Lacity, M., Fitzgerald, G., 1995. Information technology outsourcing in Europe and the USA: Assessment issues. International Journal of Information Management 15 (5), 333–351.
Wyld, D., Jones, M., Totten, J., 2005. Where is my suitcase? RFID and airline customer service. Marketing Intelligence and Planning 23 (4), 382–394.
Yee, C., Tan, K., Platts, K., 2006. Managing 'downstream' supply network: A process and tool. International Journal of Production Economics 104, 722–735.
Yeh, C.-H., Kuo, Y.-L., 2003. Evaluating passenger services of Asia-Pacific international airports. Transportation Research E 39, 35–48.
Yin, R., 2003. Case Study Research: Design and Methods, third ed. Sage Publications, Thousands Oaks.

Zairi, M., 1994. Benchmarking: The best tool for measuring competitiveness. Benchmarking for Quality Management and Technology 1 (1), 11–24.
Zeithaml, V., Parasuraman, A., Berry, L., 1985. Problems and strategies in services marketing. Journal of Marketing 49, 33–46.
Zuber-Skerritt, O., 2001. Action learning and action research: Paradigm, praxis and programs. In: Sankaran, S., Dick, B., Passfield, R., Swepson, P. (Eds.), Effective Change Management Using Action Research and Action Learning: Concepts, Frameworks, Processes and Applications. Souther Cross University Press, Lismore, Australia.