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# Demand planning based on performance measurement systems in closed loop supply chains

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#### Abstract

The operational readiness of an aircraft fleet is based on a reliable maintenance, repair and overhaul (MRO). In order to reduce the downtimes of aircrafts, damaged components are replaced on site. The need for immediate replacements associated with long lead times require spare parts stocking. To operate on a competitive basis, the optimization of the spare parts inventory level has to take place under consideration of financial and non financial aspects. In order to be able to evaluate and improve the spare parts supply process in the civil aviation industry, the formulation of a performance measurement system is subject matter of this paper. The performance measurement system presented in this paper is based on a balanced scorecard. Herewith, the complex coherences deriving from multiple participants in the closed loop supply chain can be considered by means of cause and effect relationships between the parameters used. The holistic approach leads to a performance measurement system that enables planning divisions to meet the requirements of complex closed loop supply chains and improve operating efficiency.

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### 1. Introduction

The reliable maintenance, repair and overhaul (MRO) is essential for reduced downtimes of aircrafts. Long lead times associated with immediate spare part replacements require spare part stocking. To reduce inventory cost and utilize the available life span of spare parts, their supply takes place within a closed loop supply chain, containing a central inventory. In case of a unit failure a spare part is taken from the central inventory and is sent to the requesting airport. Afterwards, the defective unit is sent back to the shop, in which the repair process takes place. The operative, tested unit is put back on stock. To operate on a competitive basis, the optimization of the spare parts inventory level has to take place under consideration of cost aspects. Therefore, key performance measurement systems can be used. Besides financial parameters, demand planning of spare parts is also influenced by non financial Traditional performance parameters.

measurement systems do not meet the requirements of closed loop supply chains and, therefore, have to be extended. In order to be able to evaluate and improve the spare parts supply process in the civil aviation industry, the formulation of a performance measurement system is subject matter of this paper. The performance measurement system presented in this paper is based on а balanced score card. Herewith, the complex coherences deriving from multiple participants in the closed loop supply chain can be considered by means of cause and effect relationships between the parameters used. By considering financial and non financial parameters like customer needs, customer satisfaction, lead time and service level, a holistic approach is possible. This leads to a performance measurement system that enables planning divisions within companies to meet the requirements of complex closed loop supply chains and improve operating efficiency.

Nomenclature	
AoG	Aircraft on Ground
LRU	Line Replaceable Unit
KPI	Key Performance Indicator
MRO	Maintenance Repair and Overhaul
TAT	Turn Around Time

#### 2. Performance Measurement

Balanced and concentrated presentation of information is the aim of performance indicators. Their relationship has to be objectively reasonable and they have to complement and declare each other [1; 2]. Performance indicators can be used to reveal weak spots within an organization or help to control and improve processes, like planning of material kept in stock.

Performance measurement systems in the field of spare parts logistics can help to achieve corporate objectives, enhance customer satisfaction, improve reliability of planning tools and reduce costs for spare parts stocking. These aims can only be monitored and achieved, if the corresponding key performance indicators are aggregated in a performance measurement system [3].

### 2.1. Traditional Performance Indicators

The enablers for performance measurement are indicators which quantify and qualify the performance of operational processes. Therefore, a common sense of the objective of measurement and the target value of the performance indicator has to be established [4]. Herewith, target-actual comparisons are possible. Target values utilize priority setting of performance indicators for the purpose of goal directed actions. Besides the functions named, there are further functions that can be fulfilled by performance indicators [5, 6]:

#### • Quantifying function

Performance indicators are used to quantify objectives.

#### • Control function

The close reference to management, planning, control and inspection functions, pose performance indicators a default and a control function as well as a control mode. Thus, the control of operational and strategic processes is enabled.

# • Information function

In management processes data plays a decisive role. By using performance indicators, the quality of information can be enhanced

#### • Coordinating function

Due to the increasing decentralization of management styles, performance indicators take up a coordinating

function. The coordination of enterprise, field and interagency targets represents an essential function.

# • Excitation function

The ongoing supervision of performance indicators enables the acquisition of irregularities. Thus, the willingness to initiate changes will be increased to achieve target values.

Important or aggregated performance indicators are denoted as key performance indicators. Key performance indicators are either derived from corporate objectives (top-down) or introduced bottom-up. The bottom-up process is based on the knowledge of operating personnel in charge and, herewith, offers more detailed performance indicators than the top-down process. In contrast to that, danger of too many performance indicators exists within the bottom-up method. To compensate disadvantages, both methods can be combined [7].

#### 2.2. Key Performance Measurement Systems

A reasonable combination of performance indicators is denoted as performance measurement system. The notation of performance measurement systems started during the 1980s [7]. In contrast to performance measurement systems, traditional systems have several disadvantages:

- Limited on information about the past;
- Limited possibility to make predictions about the future;
- Inadequate alignment with customer needs and the process orientation in general.

Today many complex and wide-reaching performance measurement systems exist, which compensate the disadvantages of traditional systems. In the following the performance pyramid, LogiBEST, and the balanced scorecard are presented. Herewith, examples for vertically integrated, supply chain oriented and highly adaptable performance measurement systems are given.

## • Performance Pyramid

The performance pyramid has been developed by 'Lynch and Cross' [8]. It is separated in four levels, which contain quantifiable aims. Every level of the pyramid represents a different hierarchical level. There are strategic aims for the whole company, customer needs, financial figures as well as performance indicators that describe aims at the level of the workshop. Each level is connected to each other by means of feedback loops. Herewith, changes and disturbances from one level can be integrated into corresponding levels and into other levels as well as into target values of specific performance indicators. Despite the feedback loops between single levels, coherences of cause and effect throughout the whole system do not exist.

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