

# Design and Improvement of KPI System for Materials Management in Power Group Enterprise

Gang Xiong, Senior Member, IEEE, Tao Qin, Feiyue Wang, Fellow, IEEE, Lei Hu, Qingsong Shi

**Abstract**—This paper mainly focuses on the study about the improvement of materials performance management in power group enterprise based on the methodology of KPI (Key Performance Indicator). Firstly, a typical KPI approach is described from the perspectives of definitions, basic principles, design procedures and relevant researches. Next, a case study on KPI system design of “G” power group is done. The KPI system of power materials management and its corresponding information system are described and analyzed, and the existing problems are found out. Ultimately, the effective methods and suggestions are proposed to solve those problems, to improve the materials performance management, and to help the decision-making for “G” power group.

**Key words**—Power Group Enterprise; Material Management; Performance Management; Key Performance Indicator (KPI)

## I. INTRODUCTION

### A. Summary of KPI

**K**ey Performance Indicator (KPI) is a measure tool of performance and such measure is commonly used to help an organization define and evaluate how successful it is, typically in terms of making progress towards its long-term organizational goals [1]. It should be defined objectively to provide a quantifiable and measurable indication of the organizations progress towards achieving its goals. KPI can be monitored using Business Intelligence (BI) techniques to assess the present state of the business and to assist in prescribing a course of action. The act of monitoring KPI in real-time is known as Business Activity Monitoring (BAM).

It is the key to improve the performance of enterprise management efficiently by establishing a clear and reasonable KPI system. Furthermore, KPI system could be quantifiable, pre-approved and can reflect the realization process of organizational goals. It is the effective means of performance management and the driving force to promote

the real business value of a company. From the perspective of functions, KPI can be applied to show the crucial aspects of the business values based on the decomposition of the company's strategic goals, to classify the qualitative and quantitative factors and implement the strategy of company strongly, and to provide an objective basis for communicating between senior managers and lower managers of a company for the evaluation of performance management [2].

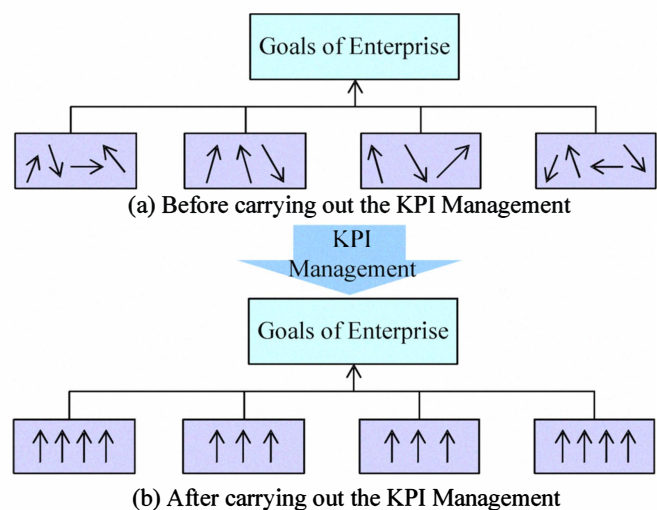


Fig.1. Supports of KPI on the strategic objectives of enterprise

Fig.1 shows the irreplaceable functions of KPI in the performance management of enterprises. Without the implementation of KPI management, sub-goals are chaotic and can't promote the strategic goal of enterprise effectively. In contrast, with the help of KPI management, the sub-goals can keep pace to achieve the top goal of enterprise effectively. For designing the KPI system on performance management, it should comply with the principles of SMART where “S”, “M”, “A”, “R”, and “T” represent Specific, Measurable, Attainable, Realistic, and Time-bound, respectively.

Currently, there is less research and discussion on the performance management about the organization of enterprise compared to the performance management about the employees. In fact, the performance management of organization reflects not only the performance of individual employees, but also the management level of leaderships, resource allocation, knowledge, teamwork, etc. Hence, it is necessary to design and optimize the organization-level KPI system to support healthy and rapid development of enterprises.

### B. Literatures

Many Chinese researchers have done lots of studies on the

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G. Xiong is a Research Professor of Key Laboratory of Complex System and Intelligent Science, Institute of Automation, Chinese Academy of Sciences, Beijing, China (corresponding author to provide phone & fax: +8601062554288; e-mail: [gangxiong@hotmail.com](mailto:gangxiong@hotmail.com)).

T. Qin is a Researcher of Key Laboratory of Complex System and Intelligent Science, Institute of Automation, CAS, Beijing, China (e-mail: [adqt@msn.com](mailto:adqt@msn.com)).

F. Y. Wang is the deputy-director of Institute of Automation, CAS, Beijing, China (e-mail: [feiyue.wang@ia.ac.cn](mailto:feiyue.wang@ia.ac.cn)).

L. Hu is IT project manager of China Guodian Corporations, Beijing, China (e-mail: [gzhulei@hotmail.com](mailto:gzhulei@hotmail.com)).

Q. S. Shi is IT manager of China Guodian Corporations, Beijing, China (e-mail: [shiqs1000@hotmail.com](mailto:shiqs1000@hotmail.com)).

performance management of employees. Our research highly focuses on the performance management about enterprise organization with the methodology of KPI. At present, some scholars finished the preliminary research and analysis about KPI management on organization. Typically, J. Ren compared and analyzed the hard-score and soft-score methods on KPI and defined the application scope [3]. C. H. Ling et al. proposed the cash flow methods to resolve the major problems existing in the performance management of enterprise [4]. B. Qian et al. finished research about how to establish KPI system in power supply plants. But they did not give efficient methods for implementing KPI system [5]. L. L. Zhou et al. proposed the methodology of the qualitative and quantitative analysis to improve the performance of material management in relevant equipment companies [6]. X. Han highly analyzed the basic procedure to establish the objective teamwork performance indicators and proposed the fundamental ideas based on the evaluation of KPI system [7]. L. Q. Yang et al. used selection and weighting methods on KPI management to improve the credibility of performance assessment [8]-[9].

Some foreign scholars finished similar research in this field too. H. Musch et al. improved the efficiency of chemical goods production by using online real-time performance analysis and evaluation methods [10]. S. R. Toora et al. improved overall project management and quality by using KPI system on the "iron triangle" in the large-scale public projects [11]. M. Alemannia et al. implemented the KPI system on the product life cycle, and validated the performance of KPI system through relevant case studies [12]. N. Saqib et al. finished research for ensuring the safety performance of nuclear power operating system by optimizing KPI system [13]. A. Alero et al. analyzed the performance management with online monitoring for power companies [14]. C. H. Liua et al. proposed the evaluation method for power enterprise performance management based on the data environment analysis technique [15].

In conclusion, there is less study on the performance evaluation for the material management of power group. This paper will focus on the performance management improvement in the organization and business field for material management in power group enterprises. Specially, "G" power group is treated as the case for our research on KPI system analysis and improvement.

## II. KPI SYSTEM ANALYSIS ON "G" POWER GROUP

Material management system of "G" power group is a comprehensive information system including the headquarters, the distribution centers and the power plants. Each has specific requirements different from others. Through the long-term development and implementation on the information system, the unreasonable designs have been revised gradually and system stability has been enhanced greatly and it saved the cost and time for system promotion. Furthermore, some intractable bottlenecks on techniques are resolved successfully. Finally, it results in the remarkable

breakthrough about KPI design and system implementation in the material management of the power group.

### A. Introduction of "G" Power Group

Recently, "G" power group improves enterprise efficiency through enhancing the materials management information system (MMIS) which is one of strong supporting platforms for managing the whole enterprise. New challenges occur while economic and technical indicators are really hard to be tracked and examined in the high-level management activities of "G" power group. How to track the active operation information of power plant timely and precisely and how to assess quantitatively are the imperative issues that manager wants to resolve. Therefore, the current problem in enterprise management is how to integrate the data resources from the headquarters, the distribution centers and the power plants. With the help of KPI system, it can support communication, coordination, organization and finished the whole process of information management on inspecting, monitoring, tracking and evaluating of business activities. Finally, the application of MMIS can be enhanced and the whole management level of enterprise can be improved greatly.

The MMIS used by the headquarters should not only meet the business needs of power plants, but also raise management level of whole group. And its decision-making is based on statistics, classification and analysis of various data from information system of power plants. The major contents of KPI system for material management of "G" power group are as follows:

- 1) It can be used for the analysis on statistical reports about data collection and multi-dimensional display of outputting results.
- 2) According to needs of management and business, the scientific KPI model is established. Meanwhile, the overall objective of materials management can be divided into quantitative, operational and contrastive sub-objectives to achieve KPI Management targets.

In particular, the KPI system for material management of "G" power group is established by using data reporting and extracting mechanism. Firstly, all data referring to indicators of KPI system are centralized. Then, the analyzed results can be obtained by date mining and analyzing mechanism and shown as charts, pie charts, histograms, trend flows, etc. Finally, the managers of headquarters, distribution centers and power plants can obtain the comprehensive and accurate information of planning, procurement, contract, storage, distribution and logistics finance timely. All information can be used to help top managers make decisions for production and management of "G" power group scientifically.

### B. Analysis on KPI Structure of "G" Power Group

The core of KPI system of "G" power group is the ability of managing all kinds of materials in power plants. Based on the sensitivity analysis of supply chain management, the ultimate satisfaction of customers and the performance evaluation of headquarters, distribution centers and power plants can be derived successfully. The whole KPI system of "G" power

group can be divided into three different levels, as follows:

- 1) *Top Level*: KPI of the headquarters includes the indicators about macro management and control of the headquarters which can be obtained through the specific indicators of the distribution centers and power plants.
- 2) *Middle Level*: KPI of distribution centers can carry out all kinds of management and performance evaluation based on the data and preliminary analysis from power plants.
- 3) *Bottom Level*: KPI of the power plants is derived from the functions of materials management and business flows.

All these three levels of KPI consist of the overall KPI system of “G” power group.

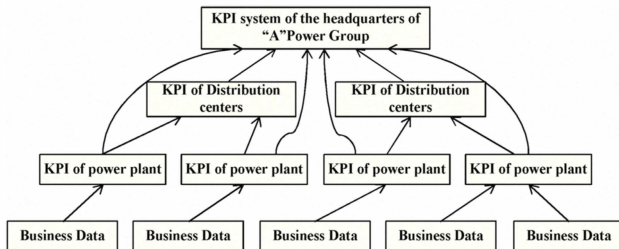


Fig.2. The structure of KPI system of “G” power group

Fig. 2 shows three different levels of KPI system for “G” power group. Typically, this KPI system includes four major aspects: administrative indicators, financial indicators, service quality indicators and operating indicators. From the view of business flows of materials management, all indicators can be classified into planning indicators, purchasing/ordering /contracting indicators, storage indicators and supply chain indicators. All indicators in KPI system of “G” power group are classified into 16 different zones and can be quantified one by one. Fig. 3 shows partial indicators of KPI system of “G” power group.

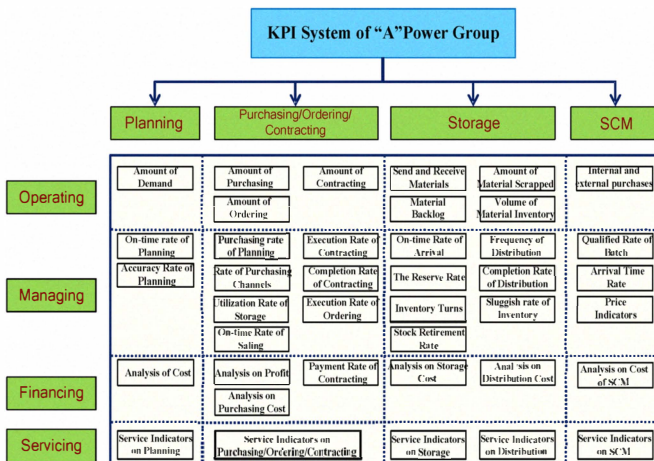


Fig.3. The classification of partial indicators of KPI system

Each indicator has its specific meaning, purpose of utilization, computing model, data sources, etc. Table I shows a detailed example about the indicator of “Percentage of inventory turns”.

TABLE I  
THE SAMPLE ABOUT PERCENTAGE OF INVENTORY TURNS

Description of the indicator	
Name	Percentage of inventory turns
Meaning	Indicators about stock liquidity in a specific duration
Purpose	Evaluating the operation and management of storage materials
Model	Percentage of inventory turns =(Total amount of outflow / Average inventory value)×100% =(total amount of outflow×2/(Value of beginning stocks + Value of ending stocks))×100%
Explanation	This indicator can be calculated by materials department and be sent to financial department.
Data collection	Materials department
Data source	Materials department, Warehouse department
Data matching	Materials department
Statistical Duration	Per week, Per month, Per year
Statistical Methods	The trend flows about the total amount of outflow, average flows, etc.

The headquarters can extract and quantify all kinds of indicators from KPI system and the linear maps are formed correspondingly. Moreover, statistical analysis is done lengthwise and breadth wise. Finally, “G” power group can improve the overall performance of materials management and make the best decisions according to informationization of KPI system.

### C. Analysis of Existing Problems

The KPI system of “G” power group is established according to the principle of “SMART”. It has promoted the materials management both the headquarters level and the power plants level. Furthermore, it optimized the control of materials utilization and the economic benefits are generated. However, due to the complexity of the material operation and management, there are still some deficiencies and problems which weaken the efficiency of material management. They are summarized as follows:

- 1) Because of many statistical indicators on power plants and less indicators on headquarters and distribution centers, it is not sufficient to support decision-making of “G” power group.
- 2) The description of indicators is not accurate and clear enough. Especially, the indicators referring to finance should be supplemented further.
- 3) Partial indicators are quite simple and can be obtained from MMIS directly.
- 4) The statistical reports are shown vaguely and every indicator has histograms and trend flows without any highpoint.

In order to resolve the existing problems, a set of methods should be given to optimize the configuration of current KPI system and guarantee the full supports of intelligent decision-making at the overall level for materials



performance management.

III. KPI MANAGEMENT IN “ASSISTED ANALYSIS SYSTEM”

A scientific KPI system can play significant role for making reasonable decisions about the macro management and control on materials management for the enterprise managers based on the sensitive changes of external environment.

The KPI system of “G” power group is embedded in the “Assisted Analysis System” of MMIS which has been carried out and operating on more than sixty power plants successfully. Fig. 4 shows the interface of the assisted analysis system.



Fig.4. The interface of “assisted analysis system”

A. Analysis on “Assisted Analysis System”

The “Assisted Analysis System” consists of 7 sub-models which have specific functions and purposes, respectively. The structure of models is shown in Fig. 5 as follows:

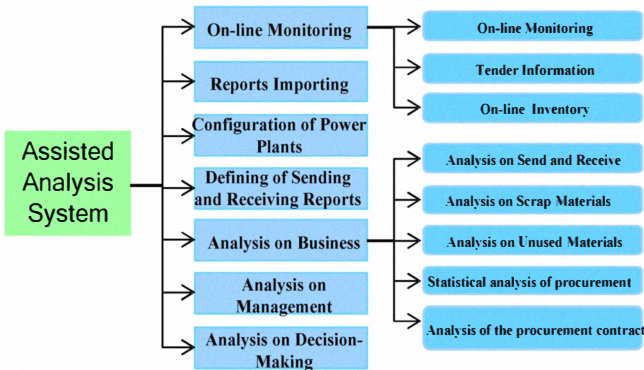


Fig.5. The structure of models in “assisted analysis system”

The model of “online monitoring” includes three main functions of online monitoring, bidding processing and online stocking. Managers can read the analyzed reports about material management of any power plant, such as planning comparison, procurement comparison, contract comparison and material purchasing comparison, etc.

The models of “reports importing”, “basic information setting of power plants” and “defining of reports on receiving and sending” mainly include assisted functions of KPI system, such as the display of all kinds of reports, the configuration of

specific power plants and the print of various reports.

The model of “business analysis” includes the main functions which are the analysis of sending and receiving, the analysis of scrapped materials, the analysis of unused materials and the statistical analysis of procurement, etc. All analyzing reports are uploaded to the model of “management analysis” for statistics analysis and decision-making support further.

The model of “management analysis” mainly focuses on the comprehensive indicators analysis and the generation of final reports to top managers for decision-making support. Furthermore, this model obtains all kinds of data and information from the model of “business analysis” firstly and then makes classification, statistics and across-the-board analysis in detail. Finally, these information and reports can be uploaded to the model of “decision-making support” and the performance evaluation and operating reports can be formed gradually for top managers making decisions on materials management.

B. Analysis of Existing Problems

“Assisted Analysis System” of “G” power group plays a significant role in the management of power materials for all power plants. It improves the level of material management effectively and reduces the incidence of inaccurate decisions. However, due to the complexity of materials management, there are still some problems about the utilizing and managing of that information system and the major problems are listed as follows:

- 1) Because the materials coding system is not completed to implement in whole information system, the accuracy of materials management information is not enough to support for making high-quality decisions.
- 2) The functions and scope of the models are indefinable. The objective of each function is unclear and the demand analysis is lack. Hence, it is necessary to make further design on the framework of those models.
- 3) Due to the irregular data inputting and outputting processing, there are some statistical errors occurred and the quality of reports is reduced somewhat.

In conclusion, an efficient and high-quality methodology should be proposed to resolve those aforementioned problems in order to improve the performance of “Assisted Analysis System” and KPI system of MMIS to support the decision-making of top managers of the headquarters and the power plants.

IV. IMPROVEMENT OF KPI SYSTEM AND “ASSISTED ANALYSIS SYSTEM”

A. Improvement of KPI System

For resolving the problems of the KPI system, some methods and suggestions are given from the perspectives of KPI procedure design and KPI management elements to analyze and optimize the whole structure.

### 1) Improvement on the procedure of KPI System

Fig. 6 shows the procedure for designing the KPI system. For optimizing the procedure of KPI system, the overall strategic targets should be defined clearly in first. Then, the relevant indicators of KPI system are built up and the corresponding standards are established. Finally, all indicators are verified scientifically and the KPI system is formed successfully.

In order to design the KPI system of “G” power group with scientific, reasonable and feasible features, some basic principles should be complied with and listed as follows:

- (1) *Goal-oriented Principles*: The design of KPI system must be based on the strategy of “G” power group for materials management.
- (2) *Operability Principles*: KPI system should be operable technically and each indicator should be defined specifically and can be understood and accepted easily.
- (3) *Targets Balance Principles*: Relevant organizations should involve with and support each other to help the targets binding based on the strategic targets of power materials management.
- (4) *Process Control Principles*: Give priority to the establishment of KPI system on inputting and outputting processes that two parts should be integrated as a whole for process control.

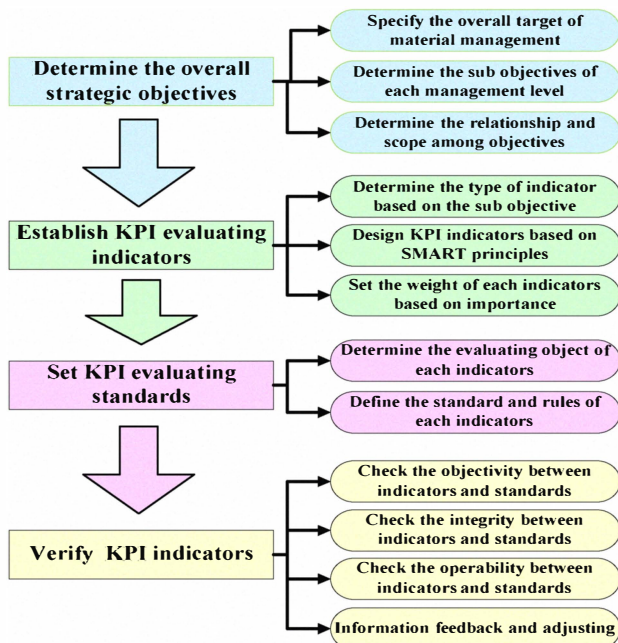


Fig.6. The procedure for optimizing KPI system

### 2) Improvement on the management elements of KPI System

For optimizing the management elements of KPI system to ensure effective supports on materials management, the management regulations, the data collecting and processing, the feedback mechanisms and the personnel management of KPI system are described and analyzed in detail, respectively.

- (1) *Management Regulations*: High-quality implementation of KPI system, regulations of basic business and data

flows, the collection of all kinds of data information and the feedback mechanisms of performance management quite need applicable, scientific and systematic management regulations to support efficient and effective materials performance management for all power plants.

- (2) *Data Collecting and Processing*: The power plants and distribution centers of “G” power group are scattered throughout the country and each plant has its specific management style and operating method. It is necessary to unify and regulate various data flows and business information in order to keep the successful implementation of KPI system.
- (3) *Establishment of Feedback Mechanism*: A practical and effective feedback mechanism should be established to uphold the efficient operating of the closed-loop for materials performance management. It can generate the improvement power continuously to make the final success of KPI management.
- (4) *Personnel Management*: Establishment of all kinds of regulations, date unification and collection, the implementation of system, analysis of reports, all require relevant persons to process. Hence, it is important to carry out the personnel management to guarantee the materials performance management.

### B. Improvement on “Assisted Analysis System”

For resolving the existing problems in “Assisted Analysis System”, such as the low accuracy and quality of reports due to the incompleteness of materials coding system, the data missing, errors and irregular operating and management, some major suggestions are given as follows:

- 1) Describe statistical indicators clearly. Describe the meaning, the model, the presentation way, data sources and technical requirements of those statistical indicators in order to get a solid foundation for further analysis.
- 2) Take more transverse analysis among power plants, such as the comparison of indicators about planning, ordering, purchasing, storage, etc.
- 3) Increase more forecasting indicators, such as the information about materials demand and utilizing. Make analysis about the distribution of material demand and help the decision-making about materials storage.
- 4) Enhance the level of materials coding management and optimize the coding system. It can keep the accuracy and quality of basic data and add more intelligent management tools for generating high-quality KPI analysis reports.
- 5) Design applicable data upload mechanism to ensure the integrity, timeliness and accuracy of data information for uploading and downloading. According to requirements of statistical analysis and needs of KPI performance management, it is necessary to establish high-quality data communication mechanism among the headquarters, the distribution centers and the power plants.

- 6) Develop indispensable interfaces for KPI system and ensure the horizontal and vertical integration with other ERP/MIS in order to keep the various data resources and the stability of system for high-quality KPI reports.

In conclusion, the problems of "Assisted Analysis System" can be resolved by using aforementioned approaches and methods. Finally it guarantees the strong support to materials management of whole group for scientific decision-making.

## V. CONCLUSIONS

This paper focuses on the study of materials performance management by using KPI methodology in power industry. Especially, the KPI system and its corresponding information system "Assisted Analysis System" are analyzed exactly. The current situation and existing problems are derived and the corresponding methods and suggestions are given for optimizing and improving the materials performance management to guarantee the scientific and applicable decision-making for managers of "G" power group.

With the help of all kinds of optimizing suggestions and methods for the improvement of materials performance management, it can decompose, execute, monitor, evaluate and analyze all data and information in the KPI system successfully. Hence, the standardization of management and the quantification of evaluation are promoted for improving the level of power materials management. In addition, with the decomposition of strategic targets, the managers can realize the importance and difficulties of materials performance management clearly. It can be the greatest driver to prompt managers to control and improve the material management to achieve the final targets of whole power group.

With the development of various technologies and theories on performance management, the intelligent forecasting and decision-making of KPI system will be a hotspot of further research. A new level of data mining on various data can combine with artificial intelligence [16] and parallel management [17] to enhance the abilities for performance management and decision-making of KPI system in future.

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