Analysis and development of a key performance indicators model for the paper industry

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Abstract. It is advisable to implement the use of key indicators by each company as a support for its continuous performant activity. Massive potential for optimisation can be found in the whole production industry. A scientific survey study has been designed and addressed to a number of companies from production industry in Europe. In the framework of this survey, the paper industry, as part of production industry, has been more profoundly analysed, in order to find the level of understanding and use of the key performance indicators and KPI systems, as an example. Based on the elements revealed by this analysis, a KPIs - Model for processes, production, financials, quality, supply chain, human resources and innovation is developed. This KPIs - Model can be a basis for the development of further KPIs – Models by any interested company, based on its specific conditions.

1. Introduction

In the past, the meaningfulness of key performance indicators, KPIs and key figure systems has been discussed intensively and extensively both in technical literature and in everyday work [1]. The potential for optimizing and improving company-specific business processes is often underestimated. In the course of day-to-day work, it is all too easy to neglect findings from key figure analysis or to take only limited or insufficient account of them [2]. The consequences are that defined goals and specifications are not achieved, adjustments of affected processes and organizational units are not carried out [3].

Current findings on the use and prevalence of various key performance indicator systems in the production industry are currently only available to a limited extent. This is a general problem of the production industry. A direct allocation to only one specific sector is to be excluded. Furthermore, all system partners are affected. Both manufacturers and suppliers show similar tendencies in the use of key performance indicators. The importance and the general benefit with regard to the use of KPIs is known to all concerned. Nevertheless, a widespread use of key performance indicators in the production industry does not exist [4]. The main reasons for this cited by the companies are the lack of know-how for the implementation of a KPI system, as well technical and IT problems during the implementation process. Another aspect mentioned is high implementation costs [5].

Ultimately, however, companies are facing ever greater challenges. Due to globalisation and a constant increase in the speed of communication, the use of key figures is essential for maintaining competitiveness. Large companies have a clear advantage over their suppliers here. SMEs in particular
are overtaxed. They are confronted with constantly increasing requirements, which will be difficult to implement without appropriate control mechanisms.

Here it is necessary to take appropriate measures in good time and to install lean and cost-effective key performance indicator systems in the company organisation. Of course, SMEs already use KPIs. However, these focus mainly on the collection of financial ratios and to a lesser extent on production ratios. This is not enough for overall corporate management. Key figures for the HR management are insufficiently used [6].

In order to be able to operate successfully in international competition in the future, SMEs in the production industry must optimise their internal and external organisational processes in a targeted manner through the use of KPIs. This requires a strategic and operational objective in the companies. Taking into account the above elements, the development of a KPIs - Model for paper industry has been considered. The term model is used as a group of key indicators from the various modules [7], a meaningful collection of KPIs that can be assigned to one or more business processes/business areas. This enables the user to select an optimized number of key performance indicators for his individual corporate management.

For development of an useful modelling system in industrial conditions, a scientific survey study has been designed and addressed to a number of companies from production industry in Europe [8]. This study is referring to Tier-1 and Tier-2 suppliers in paper industry, as part of a deployed survey study. It is to be noted that Tier-1 suppliers are the first communication partners for original equipment manufacturers (OEMs). Tier-1 companies have strong credibility, because they can generate reliable components on time and with strict adherence to standards procedures. Tier-2 suppliers are usually limited in what they can produce, smaller and with less technical advantages than Tier-1 companies.

2. Data analysis

2.1. Key facts
It is to be underlined that the content of this study is due to the fact that Tier-1 and Tier-2 suppliers and sub-suppliers of the paper industry are highly present in the considered survey study results. The share of paper industry enterprises in the whole survey was 22.8 %. In the course of study, the degree of SMEs uses of key performance indicators in the paper industry in the DACH region (DACH region - Germany, Austria and Switzerland/ German-speaking Europe) was analysed.

Fourteen Tier-1 and Tier-2 suppliers of the paper industry were basically used for this study. The distribution of Tier1 and Tier2 suppliers is approximately balanced (57 % to 43 %).

The selected individuals came from the managerial levels of reputable industrial companies and industrial suppliers of paper industry. The data were categorized appropriately. Statistical key figures were used to assess and analyse the data volume afterwards. A coding sheet or a scale rating matrix were used. The study results were verified on the basis of information and insights from specialist scientific works.

2.2. Method analysis
Let \( r \) and \( R \) be a result associated to the Tier-1 and Tier-2 suppliers paper industry, and the correspondent result associated at the level of production industry in deployed survey, respectively, i.e.

\[
  r = 100 \times \frac{s}{t}, \quad R = 100 \times \frac{S}{T}, \quad \text{in} \ %
\]

where: \( s \) and \( S \) are the number of answers given by the companies to the considered opportunity, and to the topic/question (all opportunities), respectively.

The results associated to the Tier-1 and Tier-2 suppliers from paper industry, type of \( r \), have been compared with the correspondent results associated to whole production industry, type of \( R \), in deployed survey, through the deviation (difference), \( v \).
The values of the deviation $|v|$ were divided into the following categories:

- very strong, if predominantly were greater than 20%;
- strong, if predominantly were between 10% and 20%;
- weak, if predominantly were between 5% and 10%;
- none, if predominantly were less than 5%.

It is to be noted that the deviations are positive or negative. A positive/ negative deviation shows that the considered opportunity plays a more/ less important role in paper industry than at the level of production industry in the deployed survey.

2.3. Remarks

Suppliers to the paper industry rated hurdles related to the IT system and organizational challenges +12 % higher. Expenditure concerns was valued 10 % lower (-10%). Important differences were in the linking of key figures within the company/ divisions, where there have been changes of +21 % for the answer 'yes', -35 % for the answer 'no', and +13 % for the answer 'partly'.

There are strong differences in key figure communication in the companies. The Tier-1 supplier and Tier-2 supplier use communication by mail or email much more intensively (+12 %). Verbally communication is significantly weaker (-9 %).

The topic/ question about a customer requirement for using KPIs was answered as follows. There is a strong deviation, because plus 20 % answered the question with 'yes' and this is very high in shift to the whole survey. The suppliers to the paper industry further stated that only the quality assurance- and logistics KPIs are relative important (+12 %).

A shift between process improvement (+14%) and the fulfilment of own customer demands (-13%) happened. Process/ Manufacturing KPIs and innovation/engineering development KPIs grown up (+10 %).

Logistics and supply chain KPIs lost a bit (-5 %).

The personal statement about the use of KPI knowledge for everyday work, brought a strong deviation. A plus of 11% for answer ‘agree completely’ and - 13% happened for the answers ‘do not agree’ and ‘do rather not agree’ were given.

The further development of strategic partners and suppliers is promoted much more strongly, purposefully and sustainably as in other industry groups. The Tier-1 and Tier-2 suppliers in the paper industry are also much more convinced of the benefits of key figures than the industry as a whole. It can be stated that the Tier1- and Tier 2 suppliers of the paper industry have recognized the meaningfulness of the use of key figures and actively integrate them into the work process on their own.

3. Development of KPIs – Model

Based on the results of the analysis on Tier-1 and Tier-2 suppliers in paper industry, partial above presented, a KPIs – Model has been developed for processes, production, financials, quality, supply chain, human resources, innovation, as follows.

The reference KPIs – Modules were graphically prepared in a general overview (figure 1) and show the variety of possible key figures available for the KPIs – Model development. It is to be underlined that each KPIs - Module is constituted of specific KPIs.

The KPIs – Model for paper industry has been developed as a mix of KPIs selected from KPIs – Modules associated to processes, production, financials, quality, supply chain, human resources, innovation key performance indicators as presented in figure 2.

Significant elements associated to some components of the KPIs - Model are as presented in table 1. In addition, the analytical representation of the considered KPIs – Model is proposed as the group of equations (3).
Figure 1. KPIs – Modules

Table 1. Significant elements associated to some components of the KPIs – Model

| Defining elements               | Unit of measurement           |
|---------------------------------|------------------------------|
| PCM Production capacity management | %                            |
| EA Effective availability       | hours/week or month or ...   |
| TOT Total operation time        | euro/month or quarter ...    |
| MHR Machine hour rate           | %                            |
| RM Related machine costs        | euro/month or quarter ...    |
| MR Total machine runtime costs  | euro/month or quarter ...    |
| IR Innovation rate              | %                            |
| TSI Turnover share of innovations | euro/quarter or quarter or ... |
| TNT Total net turnover          |                              |
KPI1: \( PCM = 100 \times \frac{EA}{TOT} \), KPI2: \( MHR = 100 \times \frac{RM}{MR} \), …, KPIn: \( IR = 100 \times \frac{TSI}{TNT} \) (3)

The developed KPIs – Model can be applied in practice as a prototype for Tier-1 and Tier-2 suppliers of the paper industry. Company-specific adjustments can be made at any time.

| Company: | Status report KPIs – Model | Date: DD.MM.YYYY |
|----------|---------------------------|------------------|
| Department: | | Review period: MM – MM |
| Prepared by: | | General status: |
| Approved by: | | ☐ On track |

| No. | Key performance indicator (KPI) | Status (☺ ☻ ☼) | Prospect (↑ ↔ ↓) | Notes |
|-----|--------------------------------|----------------|-----------------|-------|
| 1)  | Production capacity management | |
| 2)  | Machine hour rate | |
| 3)  | Process cost rate | |
| 4)  | Material coverage period | |
| 5)  | Return on investments | |
| 6)  | Profit or loss from ordinary business | |
| 7)  | Economic efficiency | |
| 8)  | Rejection rate | |
| 9)  | Average storage costs ratio | |
| 10) | Supplier’s service level | |
| 11) | Personnel costs ratio | |
| 12) | Innovation rate | |

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| No. | Reasons for deviations |
|-----|------------------------|
|     |                        |

| No. | Further action | Due date | Responsible |
|-----|----------------|----------|-------------|
|     |                |          |             |

| Remarks |
|---------|
|         |

Status report author: Recipients: Date of next status report: DD.MM.YYYY

Figure 3. Status report for KPIs – Model

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A simple reporting document for information and continuous review, conventional or in digital system, is proposed as presented in figure 3. Some arguments to use this simple reporting document are as follows.

- With the status report, the development of the company can take place on the basis of key figure measurements during defined review periods.
- According to the survey results, these periodic reports are mostly made weekly or monthly for Tier-1 and Tier-2 suppliers in paper industry.
- A status report supports the continuous improvement and optimization of the entrepreneurial value creation and its process landscape.
- Measures and future activities can also be documented on the status report and provided with a completion date and a responsible person.

4. Conclusions
The comparative analysis of Tier-1 and Tier-2 suppliers in paper industry and the production industry in Europe, in the framework of the deployed survey, has revealed useful data.

A KPIs - Model for processes, production, financials, quality, supply chain, human resources and innovation is developed. This can be implemented quickly, cost-effectively and easily at suppliers and sub-suppliers in the paper industry. Further KPIs - Models can be developed ensuring a continuous corporate management by means of KPIs across all corporate divisions in the paper industry.

For success as a SME company in the paper industry, it is strongly advisable to intensify the use of key performance indicators. Transparency in analysis and daily work, as well as open and honest communication throughout all levels of the organization constitute key factors for success in this endeavor. Communication and continuous work on the relevant processes are imperative.

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