Development of key performance indicators modules for small and medium-sized enterprises in production industry

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Abstract. For small or medium-sized companies in the production industry, it is strongly advisable to intensify the use of key indicators in analysis and daily work, as well as open and honest communication throughout all levels of the organization as key factors for success. Although many enterprises now run customer relationship management systems to promote professionalization in the areas of customer satisfaction and customer service, key indicator systems are rarely used in a meaningful and optimal way. Massive potential for optimisation can be found in the whole system, so that a scientific survey study has been carried out in a number of companies from production industry. Based on the elements revealed by this study, a development of key performance indicators modules is proposed and synthetically described in the present paper. This development includes a series of key performance indicator – modules covering process and production management, sales management, customer and acquisition, human resources and innovation management, as an advanced structuring system in the field of key performance indicators.

1. Introduction

The demands placed on small and medium-sized enterprises, SMEs, are constantly increasing in the production industry. Order processing is becoming more complex, customer requirements and wishes are changing rapidly. This leads to SMEs taking care of most of the day-to-day operational business. Unfortunately, the further development and improvement of the own company and its business processes suffers \cite{1}. In many cases, there is a lack of appropriate control mechanisms, or these are only partially implemented in the companies. This is a general problem of the production industry.

Key performance indicators, KPIs, are often used as a tool for monitoring, needs assessment and analysis. International standards such as DIN EN ISO 9001, ISO/IEC 27001, VDA 6.2, ISO/TS16949 and others make explicit use of the possibilities of the targeted use of key figures \cite{2}. However, the standards do not explain the individual KPIs in detail, but describe the use of KPIs to record, evaluate and analyze the specifications defined by the standards.

Accordingly, it is important that the use and introduction of key figures and KPI systems provide an accurate overview. It is necessary to analyse which are the company-specific expectations and then to verify which key figures and groups of key figures are relevant. Some examples of such key indicator groups are as follows.
For decades, financial ratios, the visualization of productivity and the economic assessment of the company have played a decisive role.

Since the 1980s, these monetary indicators have increasingly been supplemented by non-monetary indicators and developed into a management system that can depict the company in all its complexity and diversity [1]. For economic productivity, statements are made with respect to volume of sales by sales area or marginal return per customer, for instance. Economic efficiency can refer to the ratio between earnings and expenditure, performances and costs or also target costs and actual costs. Known profitability and financial key indicators are e.g. Cash flow, CF, Earnings before taxes, EBT, Earnings before interest and taxes EBIT, Earnings before interest, taxes and amortization EBITA, Profit or loss from ordinary business, EGT, Return on sales, ROS, Return on investments, ROI, Return on assets, ROA, Operating income from ordinary business, OOB [3].

Another large area is occupied by process key figures. These include production key figures, quality key figures, logistics key figures and supply chain key figures. The production capacity management, PCM, for example, is used to localise any potential cost optimisations and increase the efficiency of production processes. Material coverage period, MCP, considers the period of availability of stocked materials in a defined period. The key indicator is expressed in units of time (days, weeks or months). It analyses operating replenishment quantities. These include raw materials, utilities and supplies, as well as modules and components [3].

The quality rate examines the defect-free production quantity as a proportion of the total production quantity. The necessary data are available in the enterprise’s internal documentation. The quality rate is an essential component of the quality management system (QMS). The rejection rate describes the portion of production that is defective and must therefore be discarded. A large number of process indicators have been developed over time and used more or less intensively. Some examples of these are machine hour rate, process cost rate and follow-up costs ratio [3].

Sales and marketing KPIs are very relevant for enterprises success. Mostly of these KPIs are known, but inconsequently applied Key sales indicators are used in the strategic and operational controlling of sales. The role of sales has changed fundamentally over recent decades. The task it once had as a communicative link between market needs and the internal business service offering is scarcely relevant today. An effective sales KPI system provides the enterprise with an information system for assessing all relevant sales, as well as the customer, competitor and market situation [4]. Key sales indicators that have a target-setting function offer the opportunity to manage the entire sales process. Examples for sales KPIs are purchasing power, sales success, turnover, contribution margin, sales cost structure and others [5].

The situation is similar with regard to key marketing figures. These are usually strongly linked to the sales process in their application. The use of marketing KPIs is limited across different sectors. Typically, the applied KPIs are also only known or communicated within the marketing pipeline. An international study stated, only around 48 % of surveyed companies have qualitative criteria for measuring the success, satisfaction or awareness of a campaign [6]. Typical marketing indicators are marketing productivity, early detection, brand strength or customer lifetime value.

Other interesting KPIs could be used in human resource and -development management. These include personnel costs ratio, recruitment costs, innovation rate, talent rate, number of graduates and others [3]. Unfortunately, however, many companies work inconsistently in these areas, the managers not being yet aware of the extraordinary potential that lies dormant in these two areas.

Product responsibles can develop proper KPIs based on user experience questionnaire (UEQ). This methodology should be designed and implemented in few steps. A UEQ KPI is calculated be a specific formula, and the results can be applied within the organisation [7].

In order to optimise the development of machine tools with efficient energy consuming, multiple process controls in the machine structure and a proper group of key performance indicators should be implemented. These are focusing on "inherent energy performance (IEP)". A structured method is proposed to accomplish "IEP indexes". A case study is performed confirming the utility of the considered method [8].
2. Development of KPI modules for SMEs in production industry

Taking into account the above elements, the development of a series of modules for the description of KPIs for SMEs in the production industry has been considered.

The term module describes a group of key indicators that includes a meaningful collection of individual KPIs that can be assigned to one or more business processes/ business areas. All modules together form a modular system. This enables the user to select an optimized number of key figures for his individual corporate management.

In order to develop an useful modelling system in industrial conditions, a scientific survey study has been designed for being addressed to a number of companies from production industry.

2.1. Survey study key facts

The designed scientific survey study was carried out in the DACH region (Germany, Austria and Switzerland/ German-speaking Europe) in the production industry, and some of its key figures are presented below.

An online questionnaire was developed and filled with 58 questions. A total of 102 companies were included in the study. Among other aspects, the companies were categorised based on the generated annual turnover, staff number and activity profile. So, 44.5 % of companies are those generating an annual turnover of more than EUR 100 million, 10.3 % - an annual turnover of 50 - 100 million EUR, 6.9 % - an annual turnover of 25 - 50 million EUR, 13.8 % - an annual turnover of 10 - 25 million EUR, and around 25 % - earned an annual turnover of less than 10 million EUR. Also, around 10 % of the companies participating in the study have an employment of more than 1 000 staff, 34.5 % of companies - an employment of 250 – 1 000 staff, and 34.5 % of companies - an employment of 30 – 50 staff, and 17.2 - 20.7 % - an employment less than 30 staff. The majority of survey participants (more than 59 %) were active in general management, and around 19.4 % of the participants were working in sales, marketing or purchasing department.

A distinction must be made between micro and small enterprises with an annual turnover up to 10 million EUR or a number of employees of up to 30 persons, medium-sized enterprises with an annual turnover of 10 - 100 million EUR or a number of employees of 30 - 500 persons, and large enterprises with an annual turnover of more than 100 million EUR or a number of employees of more than 500 persons.

2.2. Development of KPI - modules

A development of a main series of the KPI - modules, based on the elements of the considered study, has been proposed as follows.

2.2.1. KPI - module for process and production management

Process-, quality- and supply chain KPIs module is proposed as presented in Figure 1. It is essential that key indicators are automatically generated in this process. Looking at the production-specific key indicators for the process, quality and supply chain area, there is minimal leeway for suppliers/ sub-suppliers as this segment is particularly subject to a range of prescribed customer requirements. The study has confirmed that this is where customers specify the highest number of key indicators on the part of suppliers/ sub-suppliers. This is explained by the prescribed quality and documentation controls.

Significant elements associated to some of the KPI-module for process and production management components (Figure 1) are as presented in Table 1. In addition, the analytical representation of the KPI-module for process and production management is proposed as the system of the formulas (1) associated to the considered KPIs.
Figure 1. Process/ Quality/ Supply chain KPIs.

Table 1. Significant elements associated to some of the KPI-module for process and production management components

| Defining elements       | Unit of measurement |
|-------------------------|---------------------|
| FIDR: Faulty incoming delivery rate | % |
| DFP: Number of delivered faulty products | pcs or service-offers or …/month or … |
| DP: Number of delivered products | |
| RR: Rejection rate | % |
| RP: Number of rejected pieces | pcs/shift or week or … |
| PP: Number of produced pieces | |
| … | … |
| ITR: Inventory turnover ratio | % |
| RP: Number of requirement products | pcs/week or month or … |
| AIP: Average inventory level of products | |

(1) \[
\begin{align*}
\text{KPI}_1: & \quad \text{FIDR} = 100 \ast \text{DFP}/\text{DP} \\
\text{KPI}_2: & \quad \text{RR} = 100 \ast \text{RP}/\text{PP} \\
\end{align*}
\]

2.2.2. KPI - module for sales management

When considering the sales and market key indicators, it is clear that there is a strong connection between the company aims, the sales targets and hence also the associated key indicator requirements in the companies (Figure 2). For the controlling of sales among suppliers/sub-suppliers, however, a concentration on key indicators that analyse sales costs, time expenditure and internal sales expenses is also recommended.

Significant elements associated to some of the KPI-module for sales management components (Figure 2) are as presented in Table 2. In addition, the analytical representation of the KPI-module for sales management is proposed as the system of the formulas (2) associated to the considered KPIs.
Figure 2. Sales and Market KPIs.

Table 2. Significant elements associated to some of the KPI-module for sales management components

| Defining elements | Unit of measurement |
|-------------------|---------------------|
| SCS: Sales cost structure | % |
| VSC: Variable enterprise sales costs | euro/week or year or ... |
| TSC: Total enterprise sales costs | % |
| MV: Market volume | |
| NT: Enterprise net turnover | euro/week or month or ... |
| TNT: Total realised net turnover | |
| ... | ... |
| PPI: Purchasing power index | % |
| PPR: Purchasing power of a region | euro/inhabitant-year |
| NPP: National overall purchasing power | |

\[ \text{KPI}_1: \text{SCS} = 100 \times \frac{\text{VSC}}{\text{TSC}} \]
\[ \text{KPI}_2: \text{MV} = 100 \times \frac{\text{NT}}{\text{TNT}} \]
\[ \text{...} \]
\[ \text{KPI}_p: \text{PPI} = 100 \times \frac{\text{PPR}}{\text{NPP}} \]

2.2.3. KPI-module for customer and acquisition

Indicators for customer and acquisition processes (Figure 3) could prove to be suitable controlling mechanisms in order to increase the company’s focus on customer needs and expectations.

Inefficiencies in the sales process and in assessing the market need to be removed from a standardised customer support mentality. Potential for optimisation can be found in the whole offer and negotiation process in sales.

Starting from the initial contact through support and processing in the offer stage, as well as negotiations, to the integration of the order in the company or customer handling in the event of a lost order, there are opportunities for increasing success. A targeted collection of offer and negotiation key indicators could reduce communication and comprehension problems in cooperation with the customer.
Significant elements associated to some of the KPI-module for customer and acquisition components (Figure 3) are as presented in Table 4. In addition, the analytical representation of the KPIs-module for customer and acquisition is proposed as the system of the formulas (3) associated to the considered KPIs.

**Table 3.** Significant elements associated to some of the KPI-module for customer and acquisition components

| Defining elements | Unit of measurement |
|-------------------|---------------------|
| CSR: Contact success rate | % |
| ACC: Arranged customer consultations | No./month or quarter or … |
| TCC: Total number of contacted customers | |
| NCR: New customer rate | % |
| NNC: Number of new customers | No./month or quarter or … |
| TNC: Total number of contacts per customer | No./week or month or … |
| … | … |
| CI: Contact intensity | % |
| NCC: Number of contacts per customer | |
| TCC: Total number of customer contacts | |

\[
\begin{align*}
\text{KPI}_1: \text{CSR} &= 100 \times \frac{\text{ACC}}{\text{TCC}} \\
\text{KPI}_2: \text{NCR} &= 100 \times \frac{\text{NNC}}{\text{TNC}} \\
\text{…} & \\
\text{KPI}_q: \text{CI} &= 100 \times \frac{\text{NCC}}{\text{TCC}}
\end{align*}
\]
2.2.4. KPI - module for human resources and innovation management

Human resource and innovation management KPIs module is proposed as presented in Figure 4. Recruiting, employee support and development, staff training, employee satisfaction and much more fall under the remit of HR management.

Significant elements associated to some of the KPI-module for human resources and innovation management components (Figure 4) are as presented in Table 4. In addition, the analytical representation of the KPIs-module for human resources and innovation management is proposed as the system of the formulas (4) associated to the considered KPIs.

![Human resources/Innovation KPIs](image)

Figure 4. Human resources/Innovation KPIs.

| Defining elements | Unit of measurement |
|-------------------|---------------------|
| RSL: Rate of sick leave | % |
| SLT: Total of sick leave time | hrs/week or month or year |
| WT: Total working time | |
| PTW: Portion of temporary workers | % |
| NTW: Number of temporary workers | No./week or month or … |
| TS: Total staff | … |
| REPR: Rate of employee performances reviews | % |
| NEPR: Number of employee performance reviews | No./week or month or quarter or year |
| TSN: Total staff number of the department (division, enterprise, etc.) | |

\[
\begin{align*}
\text{KPI}_1: & \quad \text{RSL} = 100 \times \frac{\text{SLT}}{\text{WT}} \\
\text{KPI}_2: & \quad \text{PTW} = 100 \times \frac{\text{NTW}}{\text{TS}} \\
\text{KPI}_3: & \quad \text{REPR} = 100 \times \frac{\text{NEPR}}{\text{TSN}}
\end{align*}
\]
The use of HR key indicators would enable companies to set new incentives in times of skill shortages and a high job change rate among employees within industries, in order to distinguish themselves from the market. The more transparently and objectively the value as well as performance of an employee can be analysed and assessed, the more accurately potentials can be leveraged and individual strengths localized.

The KPI - modules presented above together with other developed modules - associated to economic KPIs, profitability and financial KPIs, offers-price-delivery KPIs and marketing KPIs - makes it possible to generate a lean and efficient key figure model based on knowledge of the individual company situation.

3. Conclusions
The production, sales, personnel expenditure, employee quality and innovation performance of the company can be depicted in a structured manner.

The series of the proposed KPI - modules for process and production management, sales management, customer and acquisition, human resources and innovation management represent an advanced structuring system in the field of key performance indicators.

Intelligent KPI management in human resources can tremendously increase the likelihood that people decide to join the company and stay there for the medium to long-term. Transparency in analysis and daily work, as well as open and honest communication throughout all levels of the organisation constitute key factors for success in this endeavour.

Appropriate use of digital information platforms will become incredibly important and decisive in the future. For success as a small or medium-sized company in the production industry, it is strongly advisable to intensify the use of key indicators in innovation and human resource management. In turn, this means that managers in particular have to bear the responsibility to introduce and implement this philosophy on a consistent basis. Communication and continuous work on the relevant processes are therefore imperative.

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