



**MINISTRY OF EDUCATION AND RESEARCH**  
**University POLITEHNICA of Bucharest**  
**Doctoral School of**  
**Industrial Engineering and Robotics**

**UPB-CSUD Decision no. 661/ 29.03.2021**

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**PhD THESIS**

**\* Summary \***

**Contributions to the development on modules,  
models and use of key performance indicators  
for SMEs in the production industry/  
Contribuții la dezvoltarea de module, modele și  
utilizare privind indicatorii cheie de performanță  
pentru IMM din industria de producție**

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## Keywords

Key Performance Indicator \*KPI\*, KPI - Module, KPI – Model, Key Performance Indicator System, SMEs, Production industry, Manufacturing industry, Paper Industry, Supplier, Sub-supplier, Tier-supplier, Original Equipment Manufacturer \*OEM\*, DuPont key performance indicator system, ZVEI key performance indicator system, RL key performance indicator system, Balanced Scorecard, Process KPIs, Production KPIs, Financial KPIs, Quality KPIs, Supply chain KPIs, Sales KPIs, Customer KPIs, Marketing KPIs, Human resources KPIs, Innovation KPIs

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## ***Foreword***

The research and development on performance measuring systems in production industry represent the *motivation* and *direction* of the doctoral studies, finalised by this doctoral thesis.

The doctoral activity comprised preparation, presentation and defense of examinations and scientific reports, thorough literature study, introduction and development of new categories/modules and models on key performance indicators for small and medium-sized enterprises in production industry, creation and publishing of scientific papers, as well as the elaboration of the present doctoral thesis.

I address my special thanks to my PhD advisor, Prof. univ. dr. ing. Marian GHEORGHE, for his great commitment, expert advice and support in the preparation of this thesis. His constructive suggestions and comments, as well as his excellent communication and discussion skills provided an important contribution to the success of this work.

I address profound thanks to Prof. univ. em. dr. ing. Aurel STURZU, Conf. univ. dr. ing. jur. Mihail PURCĂREA, Conf. univ. dr. ing. mat. Ovidiu BLĂJINĂ, Conf. univ. dr. ing. Ovidiu ALUPEI, Lecturer univ. dr. ing. Cătălin GHEORGHITĂ, and Lecturer univ. dr. ing. Daniel MANOLACHE, from University POLITEHNICA of Bucharest, UPB, for their comments and proposals, within scientific evaluation commissions for doctoral exams and reports, as well as for preliminary presentation of the PhD Thesis.

I express my respectful thanks to Prof. univ. dr. ing. Nicolae IONESCU, from University POLITEHNICA of Bucharest, Conf. univ. dr. ing. mat. Ovidiu BLĂJINĂ - University POLITEHNICA of Bucharest, Prof. univ. dr. ing. Laurențiu SLĂTINEANU – “Gheorghe Asachi” Technical University of Iași, Prof. univ. dr. ing. Gheorghe OANCEA - Transilvania University of Brașov for their comments and recommendations as president and members of the official Doctorate Commission for scientific assessment and examination during public presentation of the PhD Thesis.

I express my sincere gratitude, also, to the entire organisation team of the University POLITEHNICA of Bucharest.

In addition, I thank my wife Kerstin Tieber-Plank for her unfailing optimism and her great moral support during the preparation of this work.

I hereby underline that I have accomplished this doctoral thesis through my direct analysis and development activity, based on referenced scientific resources, within the doctoral school collaborative environment.

*Alfred Tieber*

## Introduction

Key performance indicators have been playing an important role in various economic sectors for several decades. Over the course of time, the number of indicators as well as their significance have risen continuously. The driving actions of this development came especially from the business administration and manufacturing industry.

This acceleration in the use of key performance indicators in different specific business processes also meant that the use of key indicators became increasingly relevant for suppliers and sub-suppliers. Multinational corporations often run dedicated departments or employ an array of staff in business divisions for generating and implementing their specific key indicator systems. The specific expense is typically unaffordable for their suppliers and sub-suppliers, or may only be implemented at considerable additional cost. Moreover, there are differences with respect to the key indicators represented between industrial customers. However, such of indicators are useful for the internal corporate management of small and medium-sized enterprises, suppliers and sub-suppliers.

\* \* \*

The present PhD thesis develops a series of important theoretical and applicative elements on key performance indicators, KPIs, associated to small and medium-sized enterprises, SMEs, in the production industry, to support quality and profit in a sustainable development process.

The first part of this thesis, based on the analysis of the actual state of the art on key performance indicator systems in production industry, presents relevant data concerning definition, categories, practical implementation and use, conclusions.

The second part of the thesis, taking into account the data and conclusions detached from the actual state of the art analysis, starts by presenting: research and development directions as being of perspective; the main objective of the foremost doctoral activity determined as: introduction and development of useful proper modules and models of KPIs for SMEs in production industry; reference methodological elements.

Further, the main achievements are presented, i.e.: the design, unrolling and resulted states analysis of a scientific survey study concerning the key performance indicators use by the small and medium-sized enterprises from the production industry DACH region (Germany, Austria and Switzerland/ German-speaking Europe); development of key performance indicators modules for SMEs in the production industry, as KPIs – Module for processes, KPIs – Module for production, KPIs – Module for financials, ..., KPIs – Module for innovation; development of key performance indicators models levels 1, 2, and 3 for SMEs in the production industry, as Level 1/ 2/ 3 KPIs – Model for processes and production, Level 1/ 2/ 3 KPIs – Model for sales and marketing, Level 1/ 2/ 3 KPIs – Model for quality management; case study om Tier-1 and Tier-2 suppliers and sub-suppliers in paper industry.

The *scientific importance* of the thesis is sustained by its contributions to the development of key performance indicators modules and models, defined through conceptual elements and equations, for small and medium-sized enterprises in the production industry.

It is to be highlighted that, as *potential perspective*, the problematics of development and implementation of proper key performance indicators modules and models, through conventional or digital systems in compliance with companies specific profile and resources, requires a complex, continuous and profound research and applicative development activity.

***Part I.***

**The actual state of the art on  
key performance indicator systems  
in production industry**

## Chapter 1. Terms, functions and classification of key performance indicators

### 1.1. Terms key performance indicator and key performance indicator systems

There has been intensive and far-reaching discussion regarding the terms Key Performance Indicator, KPI, and key performance indicator systems in both specialist literature and in everyday working life. The potential for optimising and improving company-specific business processes was and is often underestimated in practice [S03].

Over the course of day-to-day work, it is all too easy for findings from key performance indicator analysis to be neglected or considered to only a limited or inadequate extent. Consequently, this leads to set targets and specifications not being met, while useful adaptations or adjustments to the relevant processes and organisational units are not executed. Current insights on the use and prevalence of various key performance indicator systems for small and medium-sized enterprises in production industry have been not analysed and documented in an extended way [B04, E01, G03].

KPIs are often used as a tool for monitoring, needs assessment and analysis. They serve as control and improvement instrument for the quality management system and for the optimization of business processes application. International standards such as DIN EN ISO 9001, ISO/IEC 27001, VDA 6.2, VDA 6.4, ISO/TS16949 and others explicitly use the possibilities of the targeted use of key performance indicators. Thus attempt to establish fundamental standards in the use of key performance indicators [B12, B13, S04].

The repertoire of KPIs became larger and more specific, thereby enabling even more purposeful business controlling [D02]. An evolution of performance measurement systems over the last 40 years is presented in Fig. 1.1.

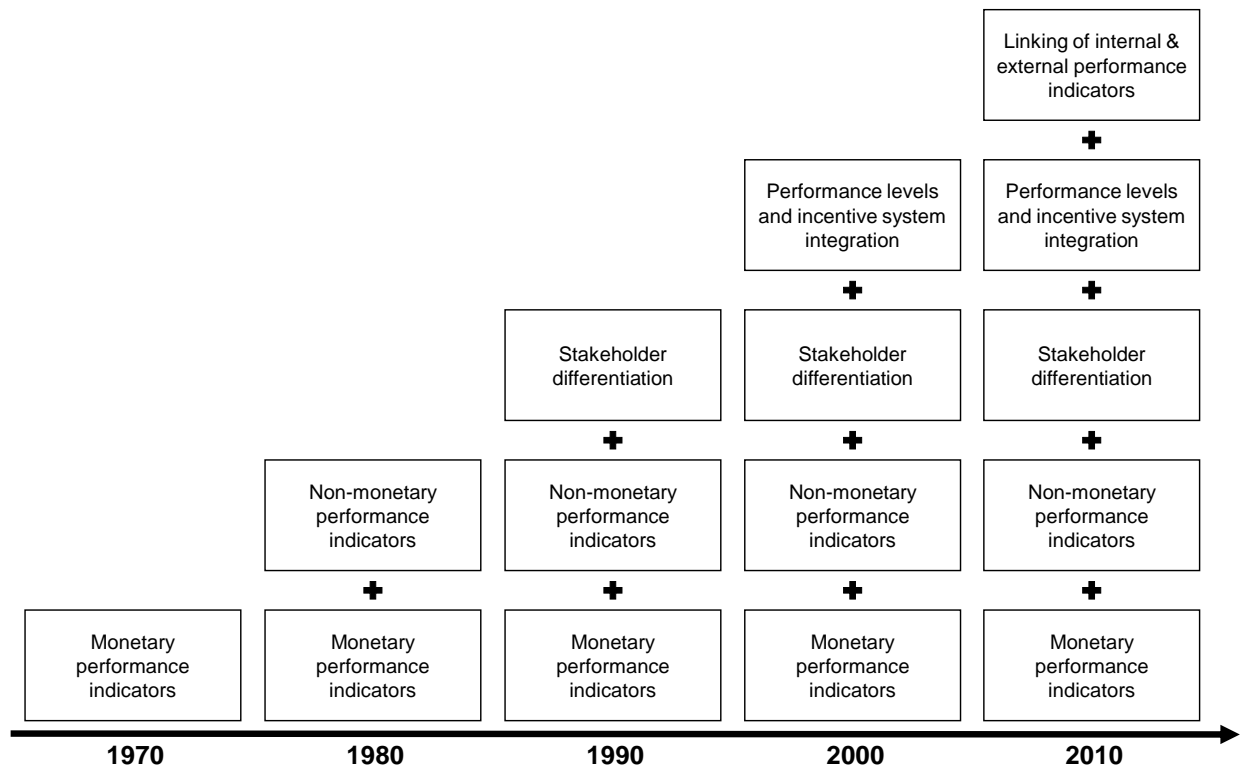


Fig. 1.1. An evolution of performance measurement system [P03, with own modifications]

A modern definition describes selected KPIs with five characteristics [W02]:

- They can be assigned to distinct goals
- Their names signify their exact meaning
- They unambiguously explain the key element
- They are part of a holistic view of the company
- They can be generated at justifiable cost.

KPIs can be used as a management tool, but may also serve as a controlling instrument. This requires that corresponding target agreements are linked to KPIs in order that they be used to measure target achievement (Fig. 1.2).

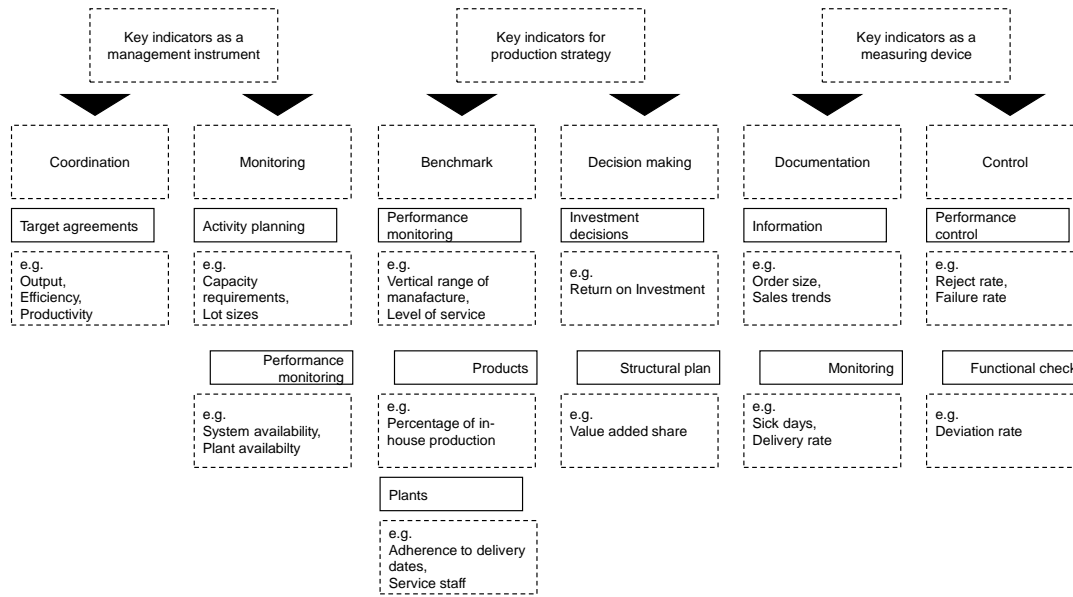


Fig. 1.2. Application of KPIs from a production perspective [G02, with own modifications]

An innovative performance measurement system, PMS is based on values, oriented for the long term and has a clear customer focus. Team-based and cross-departmental KPIs play an important role [N01]. The enterprise pursues the objective of continuous, holistic improvement involving all departments, partner institutions and staff is presented in Table 1.1.

Table 1.1. Traditional and innovating PMS [P03, with own modifications]

	PMS Development	
	Traditional PMS	Innovating PMS
Concept	Cost/ Benefit based	Value based
Conformity of different performances	Conflicts between services	Compatibility between services
Focus	Profit oriented	Customer oriented
Orientation	Short term	Short and long term
Type of key performance indicators	Individual & function specific KPIs	Team and cross - functional KPIs
Monitoring prospects	Compared to standards	Continuous improvement
Purpose	Performance evaluation	Evaluation and active participation of staff

## 1.2. DuPont key performance indicator system

The DuPont key performance indicator system concentrated on a purely monetary key performance indicator, ROI, which represents the overall profitability of an enterprise. It comprised an analysis and depiction of existing results. Profit maximisation was not the principal concern. It represents the determination of return on an operating asset. The benefit of this approach was that this key performance indicator provides both a monitoring and control function [B05, G01, J01].

## 1.3. ZVEI key performance indicator system

It can be considered an industry-neutral system, although it was originally developed by the Central Association for Electrotechnical Industry ('Zentralverband der Elektrotechnischen Industrie'). It applies over 60 main key performance indicators and more than 70 auxiliary key performance indicators [B04, G03].



#### 1.4. RL key performance indicator system

The profitability-liquidity key performance indicator system (RL key performance indicator system) provides top management (executive management and the board of directors) a holistic overview of the current corporate situation at any time (Fig. 1.5).

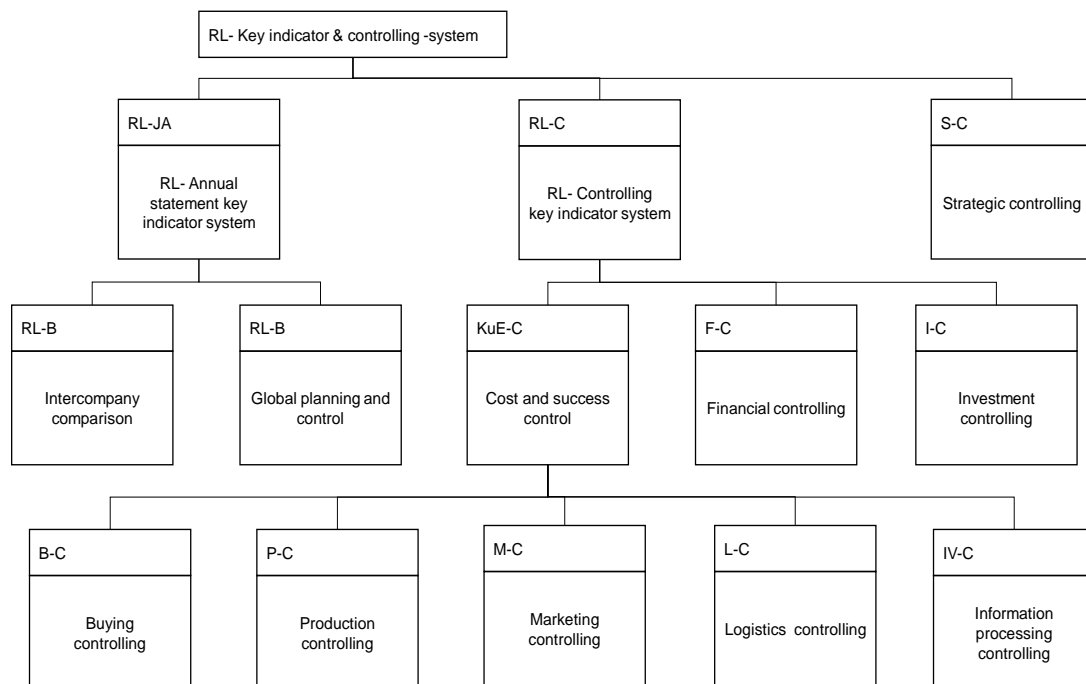


Fig. 1.5. The RL key performance indicator system [R02, with own modifications]

#### 1.5. Use of KPIs in production industry

KPIs are applied in a wide range of ways. Generally, it is true to say that they are used for both internal as well as external process assessments. In particular, external key performance indicator analyses are conventionally grounded in balance sheet analysis and intercompany comparisons.

#### 1.6. Types of key performance indicators

One of the conventional categorisations often prescribes the classification of KPIs according to functional area [E01]:

- Economic KPIs (Ratio of material costs, Consumption discrepancies)
- Production KPIs (Productivity, Plant/operational performance, Capacity utilisation)
- Process KPIs (Group/team development, Order and cleanliness)
- Logistical KPIs (Delivery capacity, Warehouse inventory value)
- Quality KPIs (Reject rate, Return rate)
- Customer/supplier KPIs ( Ratio of installation complaints, Delivery reliability)
- Environmental KPIs (Energy consumption, Waste management)
- Statutory KPIs (Accident frequency, Emission values)

The use of KPIs and key performance indicator systems varies from enterprise to enterprise. A general requirement for mandatory use of all KPIs would therefore prove impractical. It is particularly important to note that the respective beneficial values are filtered out before the actual use of KPIs. This depends on both the industry and the respective enterprise [E01].

#### 1.7. BSC – Balanced scorecard

The balanced scorecard by *Kaplan* and *Norten* was essentially developed in the 1990s over the course of a study. There was an attempt to develop measurands and KPIs derived from a vision and strategic targets, in order to sustainably ensure the operational achievement of targets on the basis of the aforementioned strategic business considerations [G03, P02, W01].

### 1.8. International studies on the use of KPIs in industry

An in-depth literature research was conducted on international studies and scientific reports on the degree of utilization of KPIs in industry. Accordingly, it made sense to analyse the current market assessment and assessment of the future market development of this technology with regard to a well-founded use of KPIs [T03].

### 1.9. Determination of a representative sample size for valid data analysis

There is a wide range of standardized calculation methods for collecting the minimum sample for a scientific study.

A very frequently used calculation formula [M07] is (1.1):

$$n \geq \frac{N}{1 + \frac{(N-1) * \varepsilon^2}{z^2 * p * (1-p)}} \quad (1.1)$$

and another calculation formula, based on data from [V02], is (1.2):

$$n \geq \frac{N}{1 + \frac{N * \varepsilon^2}{z^2 * p * (1-p)}} \quad (1.2)$$

where:  $n$  is the minimum sample size satisfying the considered condition, i.e., representative minimum number of study participants;  $N$  – population, i.e., the number of all contacted companies;  $\varepsilon$  - the error limit/ selected tolerated error, as a percentage value and describes how often the opinions of the sample group surveyed are likely to deviate from the overall population;  $z$  - the number of standard deviations that a given fraction deviates from the mean value, used for the confidence level (how reliable a measure is);  $p$  – a percentage value describing what percentage of the sample selected participants choose a particular answer.

### 1.10. Significance of Original Equipment Manufacturer and Tier - supplier

Original Equipment Manufacturer, Tier-1 and Tier-2 supplier are common terms in the production industry. Basically, these terms are used in supply chain procedures. A supply pyramid is the structure of a supply chain, headed by the producer of the end-product, called Original Equipment Manufacturer, OEM. The suppliers of modules and systems are located downstream. These, in turn, are supplied by component suppliers who themselves purchase goods from parts suppliers. Depending on the distance from the OEM, suppliers are referred to as Tier-1, Tier-2, Tier-3, ..., Tier- $n$  suppliers [G10]. This reflects the supplier structure which is presented in Fig.1.8.

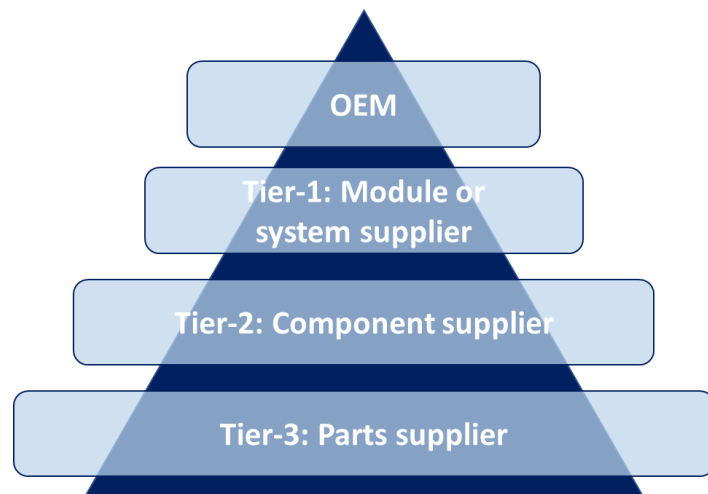


Fig. 1.8. Supplier pyramid for the automotive industry  
[E04, with own modifications]

The close interaction between OEMs and the individual tier suppliers poses particular challenges for the smooth functioning of the processes. Due to the horizontal integration of many different suppliers and their pre-suppliers, required quantities, for example, must be communicated quickly and efficiently to ensure supply.

It is far more cost effective for several companies to specialize in making certain components than for one company to generate and market products end-to-end. With Tier 1 or Tier 2 companies zeroing in on one aspect, they can make sure to get the best experts and equipment for that job. Tier-3 companies supply Tier-2 companies and Tier-2 companies supply Tier-1 companies and Tier-1 companies supply OEMs with the products needed [G10].

## **Chapter 2. Standing key performance indicators in production industry**

### **2.1. Business processes and their specific key performance indicators**

Based on the conventional business processes of production industrial businesses, the following will present individual key performance indicators and key performance indicator systems, as well as how they are determined. This systematic is presented in Table 2.1.

Table 2.1. Systematisation of key performance indicators [B06, with own modifications]

Systematisation characteristics	Types of key performance indicators						
Statistical - methodical	Key performance indicators in the area of						
	Procurement	Logistics	Production		Sales	Manpower	Finances
Business functions	Absolute numbers				Ratios		
	Single numbers	Total value	Differences	Averages	Relationship numbers	Classification numbers	Index numbers
Quantitative structure	Total size				Part size		
Time structure	Time size				Period of time size		
Content structure	Value size				Quantity size		
Epistemological value	Key performance indicators with						
	Independent value				Not independent value		
References in accounting	Key performance indicators in the area of						
	Balance		Accounting		Cost accounting		Statistics
Elements of the economical principle	Utilisation values		Result values		Standards of relations between utilisation and result values		
Range of statements	Total business key indicators				Section business key indicators		
Planning perspectives	Target key indicator values				Actual key indicator values		
Involved companies	Individual company key indicators			Group of companies key indicators		Industry key indicators	
Types of key indicators	Standard key indicators				Individual (company specific) key indicators		
Company performance	Profitability key indicators				Financial security key indicators		

#### **2.1.1. Technical and economic productivity**

General comparative measurement represents the fundamental comparison of input and output values. This concerns the classic target/actual comparison or also the combination measurement of factor output for factor input.

#### **2.1.2. Financial aspects and combination of profitability and financial indicators**

In the following analysis, the manner in which the financial key performance indicators, a number of key profitability indicators and cash flow are represented, is addressed.

### **2.2. Customer perspective**

When examining key sales indicators, customer-specific needs and requirements are also always of relevance. The information required to produce the key performance indicators is typically available in the enterprise's internal information system for the sales and marketing departments. This may concern the enterprise's own sales database, key statistical data or also order databases [K02].

### 2.3. Sales controlling

Sales key performance indicators are used in the strategic and operational controlling of sales; they quantify the sales process [K01]. A sales KPI system on a subdivision into structural analysis, profitability analysis and situation analysis are presented in Fig. 2.1.

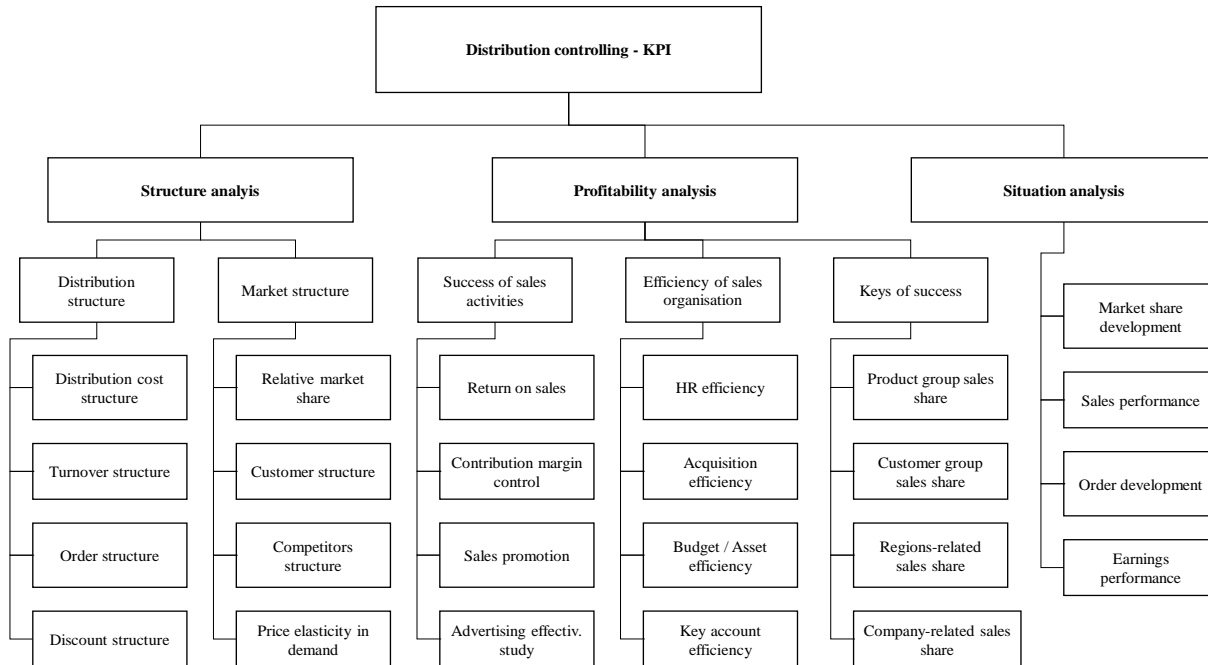


Fig. 2.1. Distribution controlling [K01, with own modifications]

### 2.4. Marketing perspective

As was the case earlier, the rule is that marketing and communication with the customer occur primarily unilaterally. Many marketing activities and campaigns still work according to the funnel principle based on the theory that the customer is supported in their purchase decision by means of ongoing information in the purchase phase [E03].

#### Selection of marketing KPIs

In addition to marketing productivity, indicators play a decisive role for early recognition (trend analyses) and structural optimisation opportunities. All this are as presented in Table 2.2.

Table 2.2. KPIs for overall marketing [G01, with own modifications]

KPI Category	Collection methodology of indicators (examples)
Marketing productivity	Total turnover/ Total marketing costs
	Market share/ Total marketing costs
	Customer satisfaction index/ Total marketing costs
	Customer loyalty index/ Total marketing costs
	Customer satisfaction index/ Total number of marketing employees
Early detection (screening)	Sector's sales, purchase power
	Commitment, awareness level, incoming orders
	Brand loyalty, customer satisfaction, customer loyalty
Structure analyses	Market share, market volume, market potential
	Ability to reduce costs, revenue structure
	Net success, contribution margin, gross sales profitability

### 2.5. Process and capacity performance measurement

The production capacity management, PCM is a percentage that defines the actual availability of production facilities. In other words, it represents the actual usage time of machines and systems for the production or performance of the ordered products and services. The total operation time is the sum of the production time, the setup and changeover time and the servicing, maintenance and repairing time. The PCM is used to localise any potential cost optimisations and increase the efficiency of production processes [K02].

## 2.6. Examples for key performance indicator implementation in production industry

Key performance indicators are currently used in different ways in the production industry. The intensity with which key performance indicators are used also varies. To illustrate this, three companies in the production industry are listed below which specifically use key performance indicators. This is intended to illustrate how individually the available key performance indicators are used in practice.

(1) The first company is active in the automotive supply industry, represents large enterprises and currently employs more than 2,000 people. The company is located in southern Austria. The enterprise is structured in a complex matrix organization and uses more than hundred different key performance indicators across all areas of the company.

(2) The second company represents medium-sized companies in German-speaking countries. The company is active in engine and plant construction and employs around 250 people. It sees itself as a high-tech company with a global customer base. Top management relies on lean organizational structures and flat hierarchies.

(3) The third company represents small enterprises of the production industry. It is a company of the IT - and electrical industry. The company specializes in fiber optic technology and works on turnkey projects in broadband expansion in Europe. It employs 48 people and is growing by 35-40 % annually.

## 2.7. Standards for scientific questionnaire, interviews and statistical calculation methods

The requirements concerning the preparation of a scientific questionnaire, scientific interviews will be analysed and an overview of statistical indicators for the evaluation of the content of studies given. The actual study of this thesis can be based on these findings.

The preparation of a scientific questionnaire, interview and statistical indicators must be carried out according to clear standardised guidelines. For this scientific work, the relevant literature is first examined as presented in Table 2.4.

Table 2.4. Questionnaire - interview and statistical standard literature

Study author(s)	Year	Data collection	Reference
Burkschat M., Cramer E., Kamps U.	2012	Descriptive statistics: Basic methods of data analysis	B07
Eckstein Peter P.	2010	Statistics for Scientists: A Real Data Based Introduction with SPSS	E02
Fahrmeir L., Heumann C., Künstler R., Pigeor I., Tutz G.	2016	Statistics: The way to data analysis	F01
Krause Hans-Ulrich, Dayanand Arora	2008	Controlling key performance indicators: bilingual manual German/ English	K02
Kirchhoff S., Kuhnt S., Lipp P., Schlawin S.	2010	The questionnaire: data basis, design and evaluation	K06
Kohn Wolfgang	2005	Statistics: data analysis and probability theory	K08
Kuckartz U., Rädiker S., Ebert T., Schehl J.	2013	Statistics: A comprehensible introduction	K09
Moosbrugger H., Kelava A.	2008	Test theory and questionnaire construction	M04
Mittag Hans-Joachim	2011	Statistics: An interactive introduction	M06
Pilshofer Birgit	2001	How do I create a questionnaire? A practical guide	P04
Porst R.	2016	CJM as an integrated methodology for a customer-centric business model	P05
Rößler I., Unterer A.	2008	Statistics for economists	R03
Schmidt Peter	2014	Statistics formulas	S05
Wester F., Soltan A., Paradies L.	2006	Assistance in designing a questionnaire	W04

An analysis of the literature (Table 2.4) shows that there is a common understanding regarding the structure of a scientific questionnaire, an interview or the calculation models for statistical indicators. Accordingly, it is possible to use standardized questionnaires, interviews and statistical key performance indicator calculations.

It should be noted, however, that in any case the general conditions of the planned investigation must be taken into account. Based on this knowledge, appropriate adaptations of the standardized agendas are possible or also necessary.

Already during the planning of the scientific survey, great importance should be attached to the choice of methods. Knowledge of the study participants and the current market situation in particular plays an important role here. Furthermore, the possibilities of data collection must be clarified in advance.

In addition to the classic personal survey, telephone surveys, online surveys and interviews are also common methods. Combinations of methods are also possible.

Classic statistical indicators are, for example, location measures like arithmetic mean, mode value, minimum and maximum, quartile 1, median/; centre value, quartile 3. The category measures of dispersion includes, mean absolute deviation, standard deviation, range, correlation and regression.

Taking these aspects into account, the creation of a standardized questionnaire, the conduct of a standardized interview, or the calculation of statistical indicators are defined. However, it should always be checked whether the content of the presentation needs to be optimised and changed for the specific application. This decision depends massively on the research question. However, data collection must always be carried out under the premises of validity, reliability and objectivity.

### **Chapter 3. Conclusions regarding the actual state of the art on key performance indicator systems in production industry**

From the analysis of the actual state of the art on KPIs, KPIs, in the production industry, important conclusions can be drawn, as follows.

- Many different approaches to defining ‘KPIs’ and ‘key performance indicator systems’ can be found in the literature. However, it could not be clearly determined whether there is a standard valid definition of these terms which applies to all industries in general.
- In principle, it is evident that there is a wide range of different KPIs and highly specialised key performance indicator systems. Some of them are used across many sectors, whereas others are only applicable in one or few specific industries. There is a commonality among all performance management systems, PMSs, and KPIs; they always pursue the aim of successfully placing the enterprise, corporation or business unit on the market strategically for the long term and they closely link the corporate strategy to the operational units in order to achieve this aim.
- KPIs are applied in a wide range of ways. Generally, it is true to say that they are used for both internal as well as external process assessments. The financial sector was the first using KPIs very early on for investment decisions regarding securities, bank lending and investments.
- Business analysis describes the attempt to draw conclusions on the current economic situation of the respective enterprise using available quantitative data and comparison with similar enterprises related to the industry. Industrial companies have begun to implement key performance indicator management systems step by step. However, the degree of use of such systems varies greatly. There is still a need for a comprehensive KPI management systems.
- Experts confirm that necessary optimisations and improvements are only carried out, if at all, following a substantial delay and are therefore much too late. Thus, the actual aim to implement the business strategy in a target-oriented manner is often an open issue.
- When specifying the business organisation and its external and internal process landscape, a number of initial key decisions are already taken with respect to PMS and KPI usage. Since the strategy is elaborated on the basis of a mission and vision, and, in turn, the business objectives are derived from the strategy, the subsequent transition of these objectives to the operational departments is also of critical importance for the use of KPIs and various key performance indicator systems.
- On the one hand, enterprises can decide to take a department-related or division-related approach. On the other hand, others may focus heavily on organising the enterprise on the basis of its processes. Depending on which of the two approaches is chosen, different KPIs can have a correspondingly stronger presence in daily usage behaviour. However, key financial indicators are always dominant.
- Criticism is growing with respect to the strong, unbalanced focus on key financial and production process indicators. Too much technical financial information and too little ‘soft’ key performance indicator values are hampering business controlling.
- Besides the distinct strength of financially oriented KPIs, production-related, logistical and quality-relevant KPIs are likewise used to a large degree. Both in theory and in practice that special attention and a considerable amount of expense are committed to developing and applying financial or production-related KPIs.
- For sales and marketing a high number of KPIs are existing. The specific literature is comprehensive and growing continuously. Due to the ever increasing globalization, new forms of business and organization are emerging. Accordingly, the requirements are changing and new indicators are constantly being created to assess the customer requirements.
- Although there has been much more intensive discourse in recent years surrounding the influential factor of people in the use of PMSs in the specialist literature, a huge amount of potential remains untapped. The number of KPIs is extensive and the options to combine them optimally usable are also. The companies in the production industry continue to make too little use of these opportunities.

- The number of KPIs and key performance indicator systems used in larger companies and organisational units has taken on inflationary proportions. The benefit and significance of these values do not lie at the heart of the effort. The decisive consideration seems to be that a visually appealing reporting document is completed on a continuous basis.
  - The number of used KPIs in production industry is extremely high. There are also several options for determining and calculating these KPIs. However, there is a basic definition of the meaningfulness of the respective key performance indicator. Due to the high number of KPIs and the different variants, a quick and targeted selection of useful KPIs is very difficult for small and medium-sized enterprises.
  - Numerous international studies confirm the high degree to which KPIs are used as a supporting controlling and decision-making tool in the production industry. Examined on the use of KPIs and KPI systems in production industry literature show that there is no fundamental implementation of KPI systems in each industry. The review of studies have shown that KPIs are used internationally. However, there are massive differences in the collection and calculation of KPIs. The communication and interpretation of key performance indicator results diverge.
  - The Balanced Scorecard, BSC, distinguishes itself from earlier key performance indicator systems by assigning various perspectives to financial and non-financial KPIs. It combines management strategy and vision with operational controls. Areas of finances, processes, resources, markets and staff are compatible with each other and that the strategic targets of the enterprise can be achieved by generating activities. The degree of BSC implementation remains low. International studies confirms this finding.
  - According to the literature review of BSCs the strategy is translated into a package of KPIs. KPIs are an expression of strategic and operational target expectations. An ongoing comparison is made between the strategic business targets and the actual process targets to avoid discrepancies. BSCs should have a strategic focus and include financial and operating measures. When using the balanced scorecard, it is important to achieve a balance between the targets in all four perspective areas (financial, customer aspects, internal business process aspects, learning and growth aspects). If this succeeds, a comprehensive management of the company is possible and a corresponding medium- and long-term positive earnings development can be expected.
  - KPI cockpit systems, KCSs, contain the strategic targets. The most important KPIs have to be defined and their target value set. A KCS is a flexible management tool that is suitable for enterprises of all sizes and sectors.
- In addition to technical financial KPI information, it primarily provides insights with respect to the functioning of an enterprise. Causes, effects, successes and failures are represented transparently.
- A literature research was conducted on international studies and scientific reports on the degree of utilization of indicators in industry. Within the production industry studies, there are sometimes significant differences in the use of specific indicators. This is due on the one hand to the industry field and on the other hand to the methodological application of the data collection.
  - Two methods for the scientific calculation of the sample size for a valid data analysis were selected and presented. One of them should be used for further studies in this thesis.
  - Different definitions for companies, suppliers, subsuppliers were found. A supply pyramid is the structure of a supply chain. The close interaction between OEMs and the individual suppliers poses particular challenges for the smooth functioning of the processes. Selected terms that are also relevant for the work have been described.
  - The terms module and model have been used as parts of different developments, e.g.: specific software modules or models; explanatory models; performance measurement or improvement models; a basic model consisting of an number of KPIs that are divided between profitability and liquidity; gap model of service quality - in relation to the reciprocal customers-company perception and expectations.
  - An analysis of standardised survey forms, interviews and also methods of calculating statistical indicators was carried out. It has been shown that an in-depth literature search is also necessary in the preparatory activities for the scientific survey. Great importance should be attached to the choice of methods.
  - A target-oriented selection to build up an scientific questionnaire or preparation for an interview document can be made by using basically a standard scientific questionnaire and interview paper. Validity, reliability and objectivity are to be maintained without fail.



***Part II.***

**Contributions to the development on groups  
and use of key performance indicators  
for SMEs in the production industry**

## **Chapter 4. Directions, main objective and methodology of research and development on modelling and use of key performance indicators for SMEs in the production industry**

### **4.1. Research and development directions**

Based on the data and conclusions drawn from the present state of the art analysis, it is assessed to be of perspective, for modelling and use of key performance indicators, KPIs, for small and medium-sized enterprises, SMEs, in the production industry, the research and development directions on:

- theoretical models and modules of representative KPIs in the production industry;
- continuous analysis of applicative levels regarding KPIs in the production industry;
- sustainable practices and technologies that have a positive influence on KPIs;
- defining and use of adequate KPIs modules for specific industrial areas, i.e., referring to manufacturing industry, car production industry, etc.

### **4.2. The main objective of research and development activity**

Taking into account the present state of the art and the above research and development directions, it is determined as main objective of the present foremost doctoral activity: **development of useful proper modules and models of KPIs for SMEs in production industry.**

### **4.3. Methodology of research and development**

#### **4.3.1. Methodological reference elements**

As a basis for future developments, including the ulterior chapters of this doctoral thesis, the methodological reference elements are as follows.

- (1) A survey of the utilization level should be taken into consideration for bringing benefits to companies involved in development process. Different advantages and risks associated with KPIs implementation will be examined with respect to the aim sustaining the quality and profit for small and medium-sized enterprises, in the context of sustainable development.
- (2) An outlined analyze is to be done regarding how the integration of KPIs will contribute to the improvement competitor situation of small and medium-sized enterprises in production industry. This should be done by a consistent evaluation of the use of KPIs.
- (3) Based on knowledge gained on the current stage of the activity of KPI implementation, the KPI solutions available on the market, it is intended to develop theoretical models and modules for the integration of KPIs.
- (4) It is the intention to generate a general framework of models for KPI implementation in small and medium-sized enterprises.
- (5) Structural data of the study have to demonstrate a balanced mix of various industry categories, company sizes and performance parameters that enable the study results to be considered as representative for the production industry.
- (6) Companies in the production industry in the DACH region are defined as the target group for the study. Over the course of collecting the data, companies in the production industry in German-speaking Europe are contacted directly and invited to take part in the study.

Through active cooperation with to the representative bodies of the Austrian Economic Chamber, the Federal Association of German Industry, the Industrial and Economic Chamber of Germany and various industrial clusters enabled more than a thousand companies to be contacted indirectly by email and newsletter dispatches.

- (7) In order to cover a wide range of industrial, it is desirable to have a corresponding number of study participants from different sectors, i.e.: mining and steel industry, chemical industry, construction industry, electrical and electronic industry, automotive industry, timber and wood industry, industrial manufacturer of paper and cardboard products, metal technology industry, non-ferrous metals industry, paper industry and stone/ceramic industry.

(8) It is also relevant to include a balanced mass of small and medium-sized enterprises and large enterprises in the study.

(9) Methods of descriptive statistics are applied and the gathered information is sorted accordingly. As soon as the data have been prepared accordingly, the data are analysed with the help of statistical key performance indicators and forms of representation, including the derivation of possible future scenarios, developments and trends.

(10) A detailed analysis on the survey data is to be unrolled with respect to suitability, usage, assessing enterprise, customer involvement, etc. associated to KPIs in production industry.

(11) In order to advance on the optimization of KPIs use, a grouping of KPIs in modules and their analytical representation are to be performed.

(12) Case studies are to be accomplished so that to strengthening the proposed theoretical development of KPIs in production industry.

#### **4.3.2. Reference structure and content of the designed and unrolled survey**

The reference structure and content of the designed and unrolled survey, according to the actual the state of the art analysis (see § 1.9 – 1.10, § 2.7), are as follows.

##### **a. Operational procedure and the requirements**

###### (1) Procedure for data collection

- The data are collected and processed on a scientific basis. At the beginning, the different data collection options are analysed in detail. Taking into account all advantages and disadvantages out the individual methods, a corresponding procedure for data collection are defined.
- The methods should be selected such that the formulation of an objective, valid and sufficiently reliable conclusion is enabled.
- The corresponding objectivity of data acquisition and the tools for evaluating data should consider suitable framework conditions and techniques.
- It is important to consider any incurred costs factors and data distortions which would automatically impact the quality of the survey results.

###### (2) Preparation of the operational questionnaire and interviews documents

- Preparation of an operational questionnaire regarding the use of different types of questions likewise affect the questionnaire to a considerable extent. The development and creation of the questionnaire is based on the common technical literature for scientific surveys and is adapted for this work according to requirements.
- Preparation of operational interviews. The development and creation of the interviews is based on the common scientific literature and is adapted for this work according to requirements.

###### (3) Preparation of the collected data

- When preparing the data, it is recommended to sort, classify and categorise the data volume appropriately.
- Use of statistical key performance indicators makes it much easier to assess and analyse the data volume afterwards.
- A coding sheet or a scale rating matrix hugely simplifies the data preparation phase.

###### (4) Procedure for the data analysis, interpretation of data results

- During data analysis, the prepared responses (from the data preparation phase) from the survey are evaluated.
- Finally forms of representation like diagrams (lines, columns, bars, etc.), normal distribution and tables used.
- A comprehensive explanation, justification and interpretation of the results completes the data analysis phase. In addition to collecting actual data and analysing the existing situation, the forecasting of future trends is especially decisive.
- As soon as the data have been prepared accordingly, the data are analysed with the help of statistical key performance indicators and forms of representation, including the derivation of possible future scenarios, developments and trends.

**b. Explanation on the specific procedure and requirements for carrying out the scientific survey**

The findings from the standard procedure were adapted accordingly for the practice.

**(1) Decision about the survey methods for the specific data collection**

● Due to the analysis of the data collection possibilities, it was decided to carry out the data collection of the study as follows.

- An online questionnaire was developed in order to collect the necessary data. The selected individuals come from the managerial levels of reputable industrial companies and industrial suppliers, as well as from associated organisations and chambers (chambers of commerce, industry clusters and industrial associations).
- Building on this online questionnaire, the content for interviews was adapted and used. Interviews are conducted with experts from the production industry in the German-speaking region.

**(2) Preparation of the specific data collection for the study**

- Data were collected on the basis of information and insights of scientific literature.
- An online questionnaire was prepared which was to be answered by industrial companies and their associated supplier companies. The questionnaire concerns an online survey.
- The online questionnaire was formulated accordingly in order to collect the necessary data and answer the research questions.
- Building on this questionnaire, the content for interviews was derived and adapted accordingly.
- Thru active cooperation with to the representative bodies of the Austrian Economic Chamber, the Federal Association of German Industry, the Industrial and Economic Chamber of Germany and various industrial clusters enabled more than a thousand companies to be contacted indirectly by email and newsletter dispatches.

**(3) Determination of the target group for the specific scientific survey**

The target group has been selected for the present scientific study as follows.

- Companies in the producing industry in the DACH region - Germany, Austria and Switzerland/ German-speaking Europe - were defined as the target group for the study, especially experts from the production industry.
- The selected individuals come from the managerial levels of reputable industrial companies and industrial suppliers, as well as from associated organisations and chambers (chambers of commerce, industry clusters and industrial associations).
- To exhibit an above-average study quality the respondents largely originate from the top management (first and second level of management) at the respective companies.

**(4) Scheduling for the specific scientific study**

- Pretest: From January to March 2017, a pretest was carried out to check the questions and survey processes developed with regard to objectivity, reliability and validity. Styria was chosen as the test area with the destinations Graz, Graz surroundings and Eastern Styria.
- The respondents were SMEs in the production industry. Based on the feedback and findings from the test phase, the questions were revised and the survey process was optimised.

**(5) Preparation of the collected data of the specific scientific study**

- The collected data were classified and categorized the data volume appropriately.
- Statistical key performance indicators were used to assess and analyse the data volume afterwards.
- A coding sheet or a scale rating matrix hugely simplified the data preparation.

- Results were converted into % values where necessary. In the calculation, care was taken to ensure that the sum of all individual values was always 100%.

(6) Data analysis, conclusions and recommendations of the specific scientific survey

- International studies served as comparison parameters for the interpretation of the results.
- Individual modules are developed on the basis of the study results taking into account the comparison with reference studies. These modules represent in their entirety the typical business processes of a company in the production industry.
- The corresponding calculation models are also developed for the developed modules.
- Case studies explain the possible application of these modules. For this purpose, a representative industry is selected from the analysed population of the study. The KPI modules were specifically adapted to the possible applications of this production industry field.
- Furthermore, on the basis of the case study, theoretical key performance indicators models for the two sub-areas investigated are created. For the two areas of the case study, corresponding reporting documents for the collection and control of key performance indicators are also being developed.
- Once the scientific study results and the case study results are available, KPIs – Modules and KPIs – Models for small and medium-sized enterprises in the production industry are developed.
- KPIs – Modules and KPIs - Models have to be created, including the necessary key performance indicator calculation methods.
- Level 1 KPIs – Model: comprises a small number of key performance indicators and is intended for start-ups, micro and small enterprises that need a small number of key performance indicators quickly and cost-effectively.
- Level 2 KPIs – Model: is recommended for SMEs already established in the market, with departments and teams comprising several members. A basic knowledge about key performance indicator controlling is recommended.
- Level 3 KPIs – Model: is prepared for Tier-1 suppliers and Tier-2 suppliers of the production industry. It provides the general management/ head of division or department with a highly effective controlling tool.
- Based on the results of the study, the conducted case study, the developed KPIs – Modules and KPIs – Models, recommendations are given for the implementation in small and medium-sized enterprises of the production industry.
- Potentials for the use of KPIs and KPI systems in the production industry are mentioned.
- Challenges, risks and opportunities for a comprehensive use of key performance indicators in the production industry from the point of view of small and medium-sized enterprises are shown.
- Conclusions and main contributions of key performance indicators for SMEs in the production industry will be given.

## **Chapter 5. Survey study on the key performance indicator system use in the production industry**

In order to develop an useful modelling of key performance indicator system in industrial conditions, a scientific survey study has been designed for being addressed to a number of companies from production industry (see § 4.3.2).

An online questionnaire was created and filled with 58 questions/ topics (see Annex 1).

The designed scientific survey study was firstly applied based on the considered questionnaire. Its main qualitative and quantitative characteristics, including the author's published elements [T01, T04, T07], are as follows.

### **5.1. Structure and size of the participant companies**

The designed scientific survey study was carried out in the DACH region (Germany, Austria and Switzerland/ German-speaking Europe) in the production industry.

For a representative study result (see § 1.9), the minimum sample size associated to the study,  $n$ , is determined based on the rel. (5.1), for: a population of 1300 companies, an error limit/ selected tolerated error of 0.1, a confidence interval of 95%, a percentage value  $p$  of 0.5, i.e.,  $N = 1300$ ,  $\varepsilon = 0.1$ ,  $z = 0.1$  and  $p = 0.5$ , respectively; it results:

$$n \geq 89.43, n = 90 \quad (5.1)$$

Thus, the minimum number of the participating companies in the envisaged study should be 90.

The answers of a total of 102 companies were included in the study.

A series of results are presented in percentages.

In the framework of whole survey, for a topic/ question, the achievement of a *certain opportunity*,  $a(w)$ , is calculated as

$$a(w) = 100 * b(w)/c(w), \text{ in } \% \quad (5.2)$$

where  $b(w)$  and  $c(w)$  are the number of answers given by the companies to the considered opportunity, and to the topic/ question (all opportunities), respectively.

Among other aspects, the companies and the staff were categorised based on the generated annual turnover, staff number, activity profile, current function/ area of responsibility, strategic responsibility, duration time in the relevant position within company, respectively.

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 24.5 % - earned an annual turnover of less than 10 million EUR.

Around 7.7 % of the companies participating in the study have an employment of more than 1 000 staff, 24.3 % of companies - an employment of 250 – 1 000 staff, 15.5 % of companies - an employment of 100 – 250 staff, 12.7 % of companies - an employment of 50 – 100 staff, 26.9 % of companies - an employment of 30 – 50 staff, and 12.9 % an employment less than 30 staff.

In total 68 % of all surveyed companies of production industries, are small and medium-sized enterprises.

The majority of survey participants (59.1 %) is active in general management, and around 26.2 % of the participants are working in sales, marketing, purchasing or controlling departments. 4.4% are working in manufacturing/ manufacturing engineering and 3.8 % in Engineering/ Research and Development departments. In human resource management and administration departments are 6.5 % of the surveyed people working.

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 50 persons, medium-sized enterprises with an annual turnover of 10 - 100 million EUR or a number of employees of 50 - 250 persons, and large enterprises with an annual turnover of more than 100 million EUR or a number of employees of more than 250 persons.

## 5.2. Use of key performance indicator system in production industry

### (1) Main characteristics

Key performance indicator requirements, usage behavior and the distribution of KPIs are considered.

All surveyed companies answered 'yes' to the question of whether they consider KPIs generally useful. Several reasons were cited for the usefulness of KPIs, as presented in Fig. 5.1.

Utilisation as a transparent controlling tool (20.3 %) helps in decision-making (17.7 %) and the initiation of changes and adjustments to company processes (16.1 %) were the most frequently named reasons. This result is similar with findings from a key performance indicator study in automotive logistics (see § 1.8).

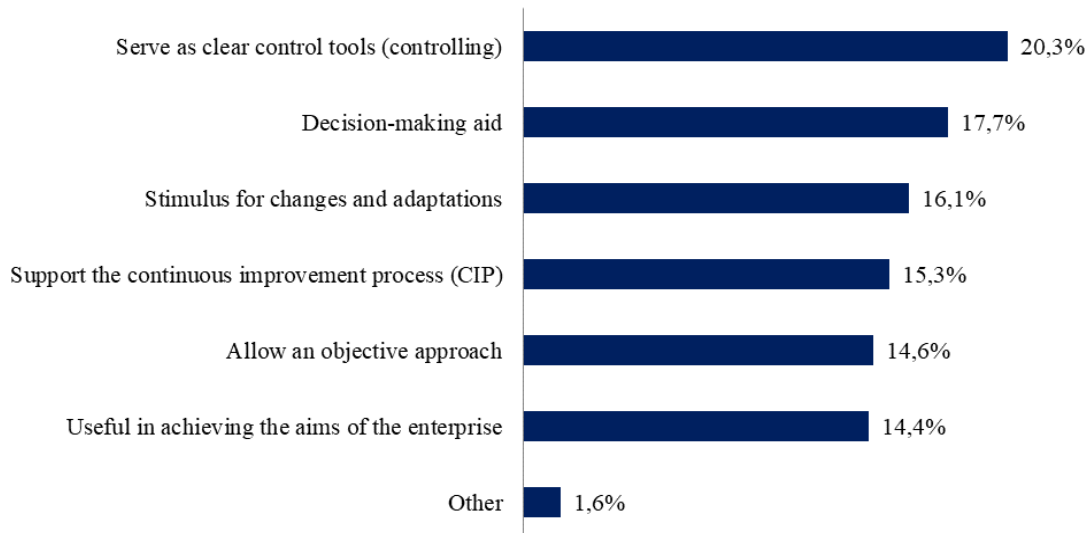


Fig. 5.1. Application of KPIs

### Categories of KPI usage

These result clearly shows that KPIs are now used intensively in companies. However, a closer look at the situation reveals that this mostly concerns quantity in data availability rather than data quality. The significance and usefulness of KPIs for future company controlling is certainly considered to be in a critical state.

### Assessing enterprise by KPIs

Besides the actual use of KPIs, the logical interrelationship between the departments and divisions of a company represents an additional benefit and efficiency increase. The study shows that around 65 % of respondents stated that a degree of interface coordination and hence also interdepartmental use of KPIs takes place either partly or full.

The key performance indicator findings are communicated via several channels. An interesting finding reveals that 83 % of respondents agree, completely or largely, that KPIs are an efficient means of assessing the enterprise. Only 6.5 % don't agree. More than 68 % agree that KPIs offer clear information and two of three respondents use knowledge of KPIs for everyday work.

Publication by means of conventional short reports and postal or email dispatches accounts for the leading communication channel (38.3 %). The use of online reports is also progressing (25.5 %). Here, the results are distributed using the company intranet or similar internal online platforms.

### Benefits of KPIs

All companies using KPIs stated (Fig. 5.4) that the KPI results led to a direct benefit. The factor of cost savings received the top rating in this regard (18.5 %). It was followed by findings on improving the company/ departmental result (17.6 %).

Third place was a match between process optimisation (for improving processes and communication) and increasing quality im provement. Soft skills such as increasing employee satisfaction or improving the company image were named significantly less frequently (< 3 %). Interestingly, increasing customer/ supplier satisfaction also only received 14 %. This is surprising, since the desire/ requirement in industry to further prioritise the field of soft KPIs is prominent.

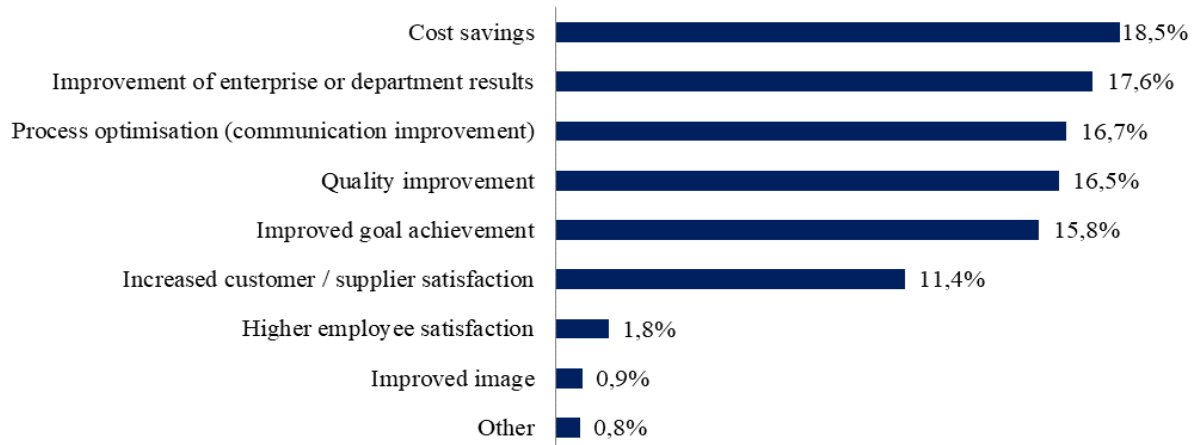


Fig. 5.4. Benefits of KPIs

#### Types of KPIs required by customers

A closer analysis of those companies that answered this question with 'yes' is presented in Fig. 5.5. It reveals that customers primarily ask for the use of KPIs in the areas of quality and logistics (~30 % in each case). Requirements in other areas were stipulated to only a much more limited extent. For example, price and sales performance as well as process and production KPIs were specified in 11 percent of cases.

Moreover, 90 % of these companies confirmed that they also know why their customers require the use of these KPIs. Interesting is, that none of the surveyed people have human resource management KPIs or economic KPIs chosen. Obviously there are no customer requirement for these KPIs.

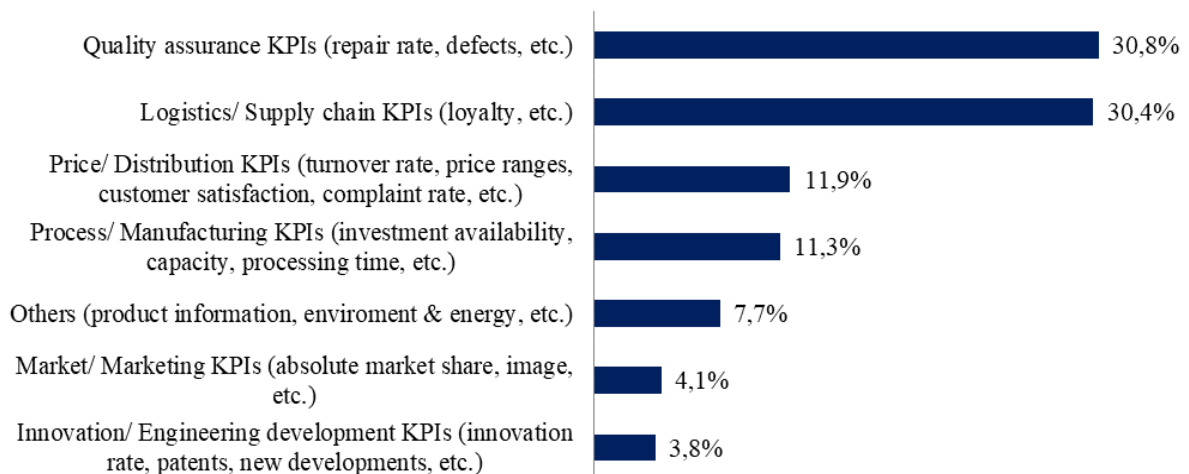


Fig. 5.5. Types of KPIs required by customers

#### **(2) Specific features of sales key performance indicators use**

The specific study demonstrates that 88.5 % of participating companies regard sales controlling as strategically important for their company. At 82.6 % of these companies, sales controlling is also performed regularly, systematically and throughout all sales areas.

Significantly, the vast majority of companies (95.7 %) have high expectations regarding substantial improvements to the company result through the use of sales controlling. KPIs are applied in an attempt to achieve specified sales targets (80.8 %), recognise potential for improvement in the sales process (69.2 %) and control the sales team or individual sales employees (65.4 %).

As a countermeasure, it is therefore crucial that sales are subject to precise controlling. Less than 50 % of the respondents of a study (see § 1.8) measure turnover by customer segment and only 38 % record turnover by customer categories. A more differentiated picture can be seen in the analysis of turnover KPIs (Fig. 5.8). Sales performance (21.1 %) and return on sales (20 %) received the most frequent mentions. They were closely followed by revenue structure (17.8 %) and customer turnover rate (16.7 %). Sales potential and sales share almost tied at around 11 to 12 %. In contrast, the purchasing power index was hardly used at all.



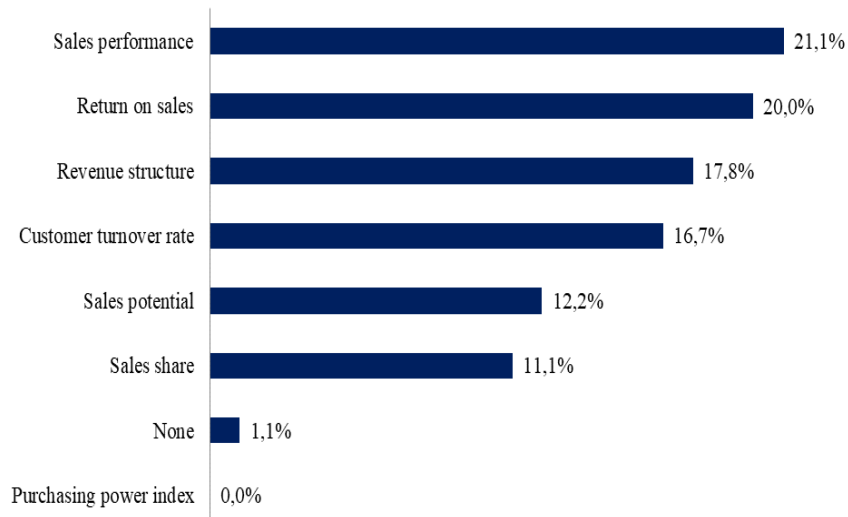


Fig. 5.8. Sales KPIs used

### Customer contact and support KPIs

Continuous customer contact is undoubtedly perceived as one of the most important controlling measures for successful sales. When asked for the use of KPIs regarding customer contact and support, 31.3 % of all companies admitted that frequency of contact is measured.

Notably, more than a third of all companies do not use any KPIs at all. 18.8 % of the surveyed people answered that they don't use a KPI to measure the contact - and support efficiency.

The customer success rate holds third place among the most frequently named KPIs, at 14.6 %. All other KPIs available received less than 10.5 %, many even significantly below 5 % (Fig. 5.10).



Fig. 5.10. Use of customer contact and support KPIs

### Complete order processing KPIs

It is clear that there is great potential for improvement, particularly in the area of customer support. The use of KPIs is rather limited both for general customer contact and customer support, as well as in offer and acquisition processes. This finding is corroborated by the survey result regarding the use of order execution/process KPIs in sales (Fig. 5.12). At 34.4 %, customer payment loyalty and the customer complaint ratio rank in the lead (34.4 %), followed by delivery reliability at 21.8 %.

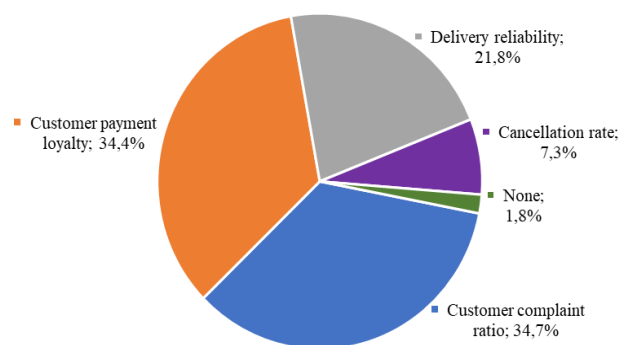


Fig. 5.12. Complete order processing KPIs

Customer KPIs

In order to clarify the effectiveness of KPI use in sales, the application of KPIs was also taken into consideration in the analysis of regular and new customers. As already demonstrated in previous studies, this analysis once again confirms that the measurement of customer satisfaction accounts for the top value (25 %). It is therefore unclear why only one in two companies uses this key performance indicator for controlling purposes (Fig. 5.13).

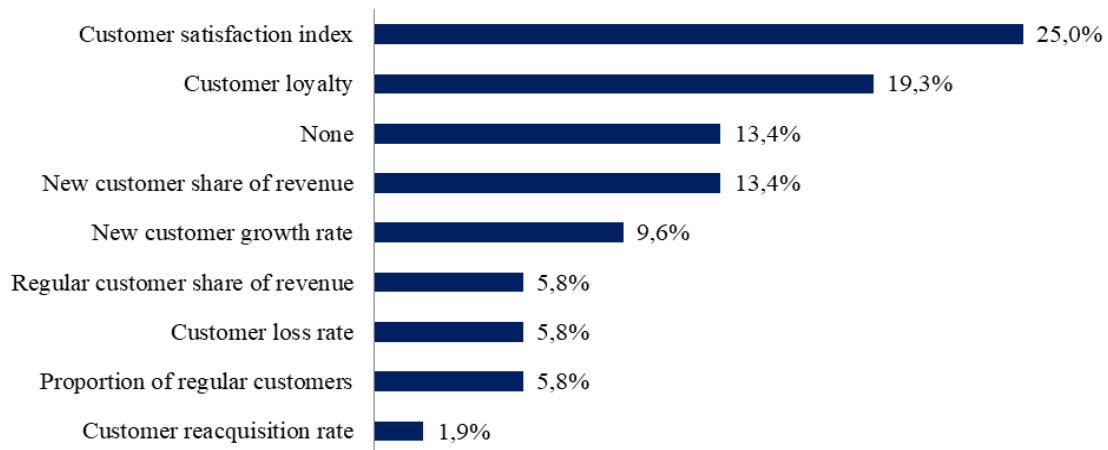


Fig. 5.13. Use of regular customer and new customer KPIs

**(3) Specific features of marketing key performance indicators use**

Marketing is another important area that deals intensively with customer needs, their expectations and external perceptions of the company. In the organization of many companies, this area is combined with sales for the attributes mentioned.

Generally, the tasks as well as the use of its KPIs are clearly defined (see Chapter 2). The focus of marketing lies on the representation of product and service quality, the acquisition of potential customers, the communication of service parameters, sales support and the establishment of the brand and its ongoing development.

Depending on the size of the company, these different issues play a role of varying importance. Larger companies tend to concentrate on innovation leadership and sales support, whereas SMEs prefer to drive the acquisition of leads as well as product and service quality.

Marketing KPIs for assessing marketing and purchase power

42.3 % of companies participating in the study stated that they use marketing KPIs on a continuous basis. Thus, more than half do not currently use any relevant KPIs. In order to assess the market and its purchasing power, which is presented in Fig. 5.15, market share (28.1 %), market volume (24.9 %), market potential (15.6 %) and name recognition (12.5 %) are the most frequently used KPIs. Total efficiency of marketing was named by 6.2 % of the participants.

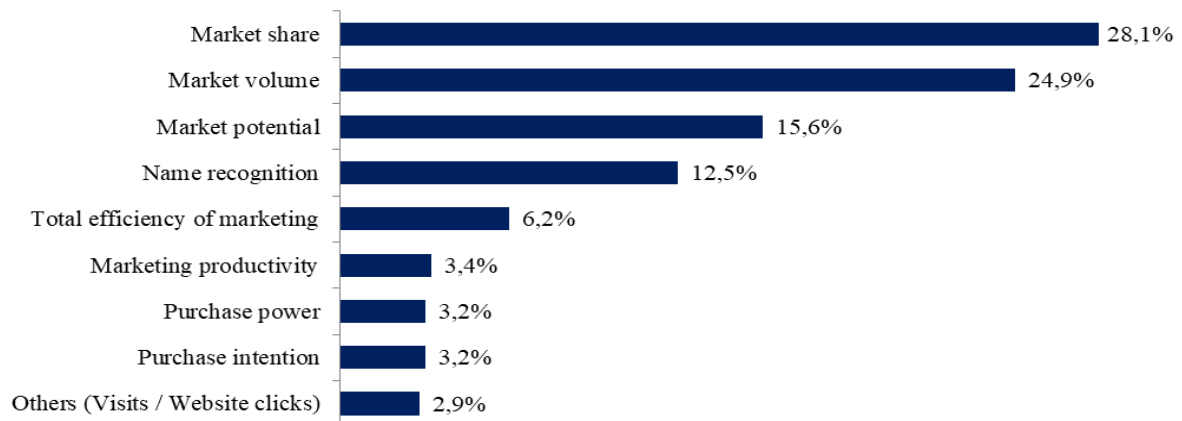


Fig. 5.15. Marketing KPIs for assessing marketing and purchase power

Internet and online marketing KPIs

The frequency of use of marketing KPIs is particularly interesting in Internet/ online marketing. Results for the frequency of said marketing KPIs is depicted in Fig. 5.17. More than 38 % of companies stated that visits/ website clicks are professionally recorded and evaluated.

Social media KPIs (28.5 %) and search engine ranking KPIs (19.1 %) are also increasingly used. Nevertheless, 14.3 % of companies confessed that they do not collect any online/ internet-specific KPIs. This is an incredibly high number – particularly in an age of rapidly advancing digitisation.

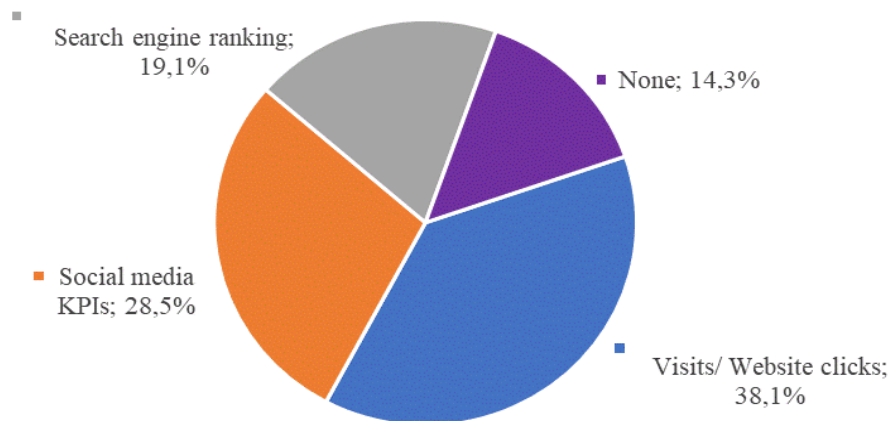


Fig. 5.17. Internet/ Online marketing KPIs

A study in which 960 companies from the technical SME sector were questioned [S08] concluded that 61 % of surveyed companies still consider offline marketing activities (classic communication and marketing) to be important or very important. In addition, companies primarily active in the B2B (Business-to-Business) segment are also recognising the importance of social media channels. Despite this fact, the budget share of online marketing has risen to 24 % currently and will already account for 33 % of the overall marketing budget by 2018 (see § 1.8).

### 5.3. Remarks on the key performance indicator system use

Based on the the findings from the literature review (see chapters 1 - 3) and the survey results of this study, it is possible to remark the followings.

None of the analysed sectors of the production industries currently has a clearly and unequivocally defined customer requirement with regard to the use of a specific key performance indicator system. The importance of KPIs for decision making, controlling, optimisation and continual process improvement is emphasised in the companies. For a limited number of KPIs, suppliers/sub-suppliers of the production industry are subject to a binding (contractually agreed) customer requirement to collect the corresponding KPI data. This is predominantly the case for production, quality and logistics KPIs.

The collection and disclosure of financial-, profitability-, process-, quality-, supply chain-, human resources- innovation management -, sales or marketing - KPIs are only requested in very few instances, if at all. This is particularly surprising as these areas of business play a mayor role and should therefore be requested more often. The importance of sales and marketing KPIs for decision making, controlling, optimisation and continual process improvement is emphasised in the companies and relevant departments for sales and marketing.

## Chapter 6. Development of key performance indicators modules for SMEs in the production industry

The development of key performance indicators modules for SMEs in the production industry, including the author's published elements [T01, T03, T04], is as follows.

### 6.1. Initial defining data

The term key performance indicators module, KPIs – Module, is considered a group of KPIs with a meaningful that can be assigned to a certain topic. Possible KPIs – Modules in production industry would be about processes, production, financials, quality, supply chain, sales, customers, acquisition, offers, orders, price, marketing, innovation, human resources.

All KPIs – Modules form a modular system. This enables the user to select an optimized number of key performance indicators for his individual corporate management.

### 6.2. A main series of key performance indicators modules

The main series of the KPIs - Module has been developed for processes, production, financials, quality, supply chain, sales, customers, acquisition, offers, orders, price, marketing, innovation, human resources, as presented in Fig. 6.0.

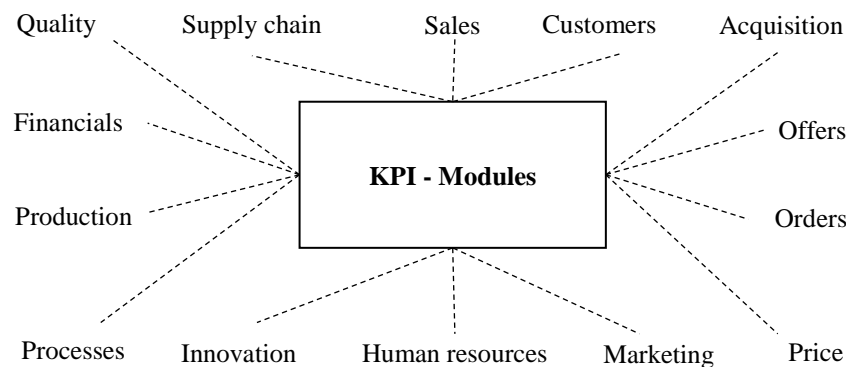


Fig. 6.0. A series of KPIs – Module

#### 6.2.1. KPIs – Module for processes

Looking at the specific key performance indicators for the process area, there is minimal leeway for suppliers as this segment is particularly subject to a range of prescribed customer requirements. A Processes KPIs – Module is proposed as presented in Fig. 6.1.

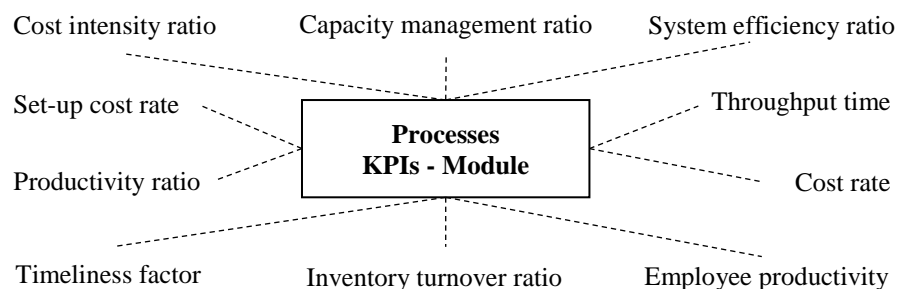


Fig. 6.1. Processes KPIs – Module

Significant elements associated to some of the Processes KPIs – Module components are as presented in Table 6.1. In addition, the analytical representation of the considered Processes KPIs – Module is proposed as the group of eq. (6.1).

Table 6.1. Significant elements associated to some of the Processes  
KPIs – Module components

Defining elements		Unit of measurement
TLF	Timeliness factor	%
ODT	Orders delivered on time	No./quarter or year or ...
TNO	Total number of orders	
PR	Productivity ratio	%
AO	Actual output	No./month or year or ...
NO	Nominal output	
...	...	...
ITR	Inventory turnover ratio	%
CGS	Cost of goods sold	euro/week or month or ...
AVI	Average monetary value of inventories	

$$\left\{ \begin{array}{l} \text{KPI}_1: \text{TLF} = 100 * \text{ODT}/\text{TNO} \\ \text{KPI}_2: \text{PR} = 100 * \text{AO}/\text{NO} \\ \dots \\ \text{KPI}_n: \text{ITR} = 100 * \text{CGS}/\text{AVI} \end{array} \right\} \quad (6.1)$$

### 6.2.2. KPIs – Module for production

A Production KPIs – Module, which possess critical relevance for suppliers and sub-suppliers, with the main aim of an efficient usage of production KPIs, is proposed as presented in Fig. 6.2, Table 6.2 and eq. (6.2). It is to stress that a relevant element is the run time, as the difference of planned production time and stop time.

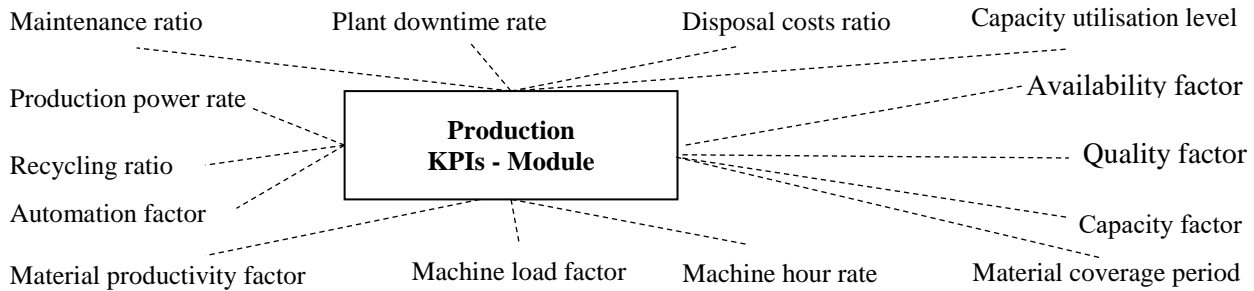


Fig. 6.2. Production KPIs – Module

Table 6.2. Significant elements associated to some of the  
Production KPIs – Module components

Defining elements		Unit of measurement
MPF	Material productivity factor	%
OQ	Output quantity	pcs/week or month or ...
MCU	Material quantity used	
AUF	Automation factor	%
APS	Automated production steps	No./production process
TPS	Total of all production steps	
...	...	...
AF	Availability factor	%
PPT	Planned production time	min/shift or week or ...
ST	Stop time	
QF	Quality factor	%
GC	Good count	pcs/shift or week or ...
TC	Total count	
CF	Capacity factor	%
ICT	Ideal cycle time	min/shift or week or ...
TC	Total count	
RT	Run time	
...	...	...
MLF	Machine load factor	%
OT	Occupancy time	min/shift or week or ...
DT	Downtime	

$$\left\{ \begin{array}{l} \text{KPI}_1: \text{MPF} = 100 * \text{OQ}/\text{MCU} \\ \text{KPI}_2: \text{AUF} = 100 * \text{APS}/\text{TPS} \\ \dots \\ \text{KPI}_{i,1}: \text{AF} = 100 * \frac{\text{PPT} - \text{ST}}{\text{PPT}} \\ \text{KPI}_{i,2}: \text{QF} = 100 * \text{GC}/\text{TC} \\ \text{KPI}_{i,3}: \text{CF} = 100 * \frac{\text{ICT} * \text{TC}}{\text{RT}} \\ \dots \\ \text{KPI}_n: \text{MLF} = 100 * \frac{\text{OT} - \text{DT}}{\text{OT}} \end{array} \right\} \quad (6.2)$$

### 6.2.3. KPIs – Module for financials

To ensure appropriate economic controlling of suppliers/ sub-suppliers in production industry, certain financials are used: profit or loss from ordinary business, cash flow, break-even point, return on sales, return on investments etc.

### 6.2.4. KPIs - Module for quality

KPIs for quality are an integral part of daily work in industry. A Quality KPIs – Module includes a selection of possible quality key performance indicators.

### 6.2.5. KPIs – Module for supply chain

Supply chain is the process-oriented planning and control of relevant information, data, products, etc. across the entire internal and external value chain.

### 6.2.6. KPIs – Module for sales

There is a strong connection between the company aims, the sales targets and hence also the associated key performance indicator requirements in the companies. Thus, a Sales KPIs – Module is as presented in Fig. 6.6.

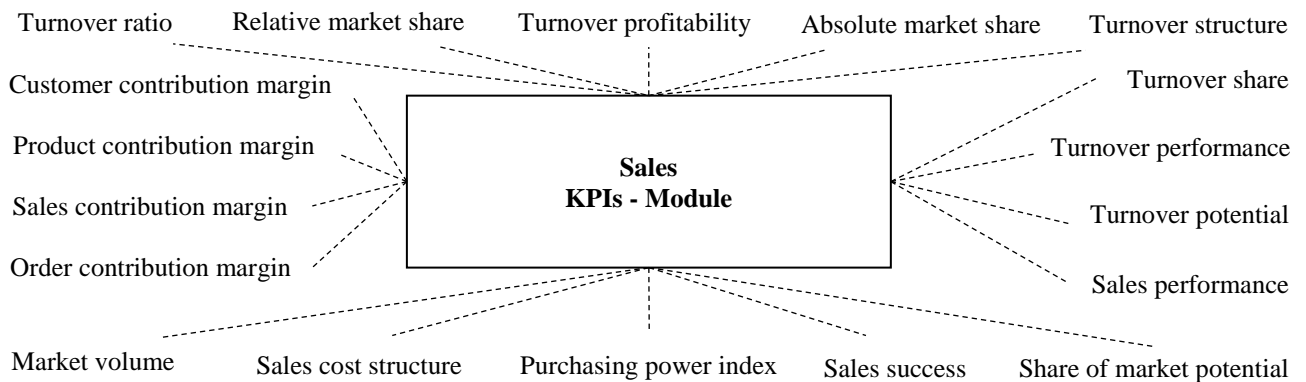


Fig 6.6. Sales KPIs – Module

Significant elements associated to some of the Sales KPIs – Module components are as presented in Table 6.6. In addition, the analytical representation of the considered Sales KPIs – Module is proposed as the group of eq. (6.6).

Table 6.6. Significant elements associated to some of the  
Sales KPIs – Module components

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

$$\left\{ \begin{array}{l} KPI_1: SCS = 100 * VSC/TSC \\ KPI_2: MV = 100 * NT/TNT \\ ... \\ KPI_n: PPI = 100 * PPR/NPP \end{array} \right\} \quad (6.6)$$

### 6.2.7. KPIs - Module for customers

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.

### 6.2.8. KPIs – Module for acquisition

Starting from the initial contact through support and processing in the negotiation stage, to the integration of the order in the company, there are opportunities for increasing success.

**6.2.9. KPIs – Module for offers**

Offers refer to the quantity of goods, products or services that are prepared for sale. Following the offer phase, is ascribed vital importance in business sales processes.

**6.2.10. KPIs – Module for orders**

Orders encompass the indicators for incoming orders and their development. Following the order phase, the order completion phase is ascribed vital importance in business sales processes. Significant elements associated to some of the Orders KPIs – Module components are as presented in Table 6.10. In addition, the analytical representation of the Orders KPIs – Module is proposed as the group of eq. (6.10) associated to the considered KPIs.

Table 6.10. Significant elements associated to some of the  
Orders KPIs – Module components

Defining elements		Unit of measurement
CR	Cancellation rate	%
CO	Net turnover of cancelled orders	euro/month or quarter or ...
TNT	Total net turnover	
OCR	Order cost rate	%
OC	Order costs	euro/quarter or year or ...
TNT	Total net turnover	
NOR	New customer order rate	%
NCO	Number of new customer orders	No./quarter or year or ...
TNO	Total number of orders	
IOP	Incoming order performance	%
OP	Number of incoming orders	No./week or month or ...
PP	Number of previous incoming orders	

$$\left\{ \begin{array}{l} \text{KPI}_1: \text{CR} = 100 * \text{CO}/\text{TNT} \\ \text{KPI}_2: \text{OCR} = 100 * \text{OC}/\text{TNT} \\ \text{KPI}_3: \text{NOR} = 100 * \text{NCO}/\text{TNO} \\ \text{KPI}_4: \text{IOP} = 100 * \text{OP}/\text{PP} \end{array} \right\} \quad (6.10)$$
**6.2.11. KPIs – Module for price**

Price formation and the handling of prices have an immense influence on sales management and the success of the company. It is important to pursue a transparent pricing policy and to continuously monitor how this is handled.

**6.2.12. KPIs – Module for marketing**

Marketing can have an enormous impact if used in a targeted manner. The essence of marketing is often boiled down to the advertising of products and services, but it is more. Marketing considers the strong connection between the company aims, the sales agendas and hence also the associated key performance indicator requirements in the companies. A Marketing KPIs – Module is proposed as presented in Fig. 6.12, Table 6.12 and eq. (6.12).

Table 6.12. Significant elements associated to some of the  
Marketing KPIs – Module components

Defining elements		Unit of measurement
BA	Brand awareness	%
RPS	Respondents who recognize the product or service	Number of respondents/week or month or ...
TR	Total respondents	
WV	Website visits	%
CR	Number of clicks through	pcs/month or quarter or ...
CI	Number of impressions	
...	...	...
MP	Marketing productivity	%
PF	Profit	euro/year or quarter or ...
TMC	Total marketing cost	

$$\left\{ \begin{array}{l} \text{KPI}_1: \text{BA} = 100 * \text{RPS}/\text{TR} \\ \text{KPI}_2: \text{WV} = 100 * \text{CR}/\text{CI} \\ \dots \\ \text{KPI}_n: \text{MP} = 100 * \text{PF}/\text{TMC} \end{array} \right\} \quad (6.12)$$

### 6.2.13. KPIs – Module for human resources

Recruiting, employee support and development, staff training, employee satisfaction and much more fall under the remit of human resources. A Human resources KPIs – Module is proposed as presented in Fig. 6.13.

Significant elements associated to some of the Human resources KPIs – Module components are as presented in Table 6.13. In addition, the analytical representation of the Human resources KPIs – Module is proposed as the group of eq. (6.13) associated to the considered KPIs.

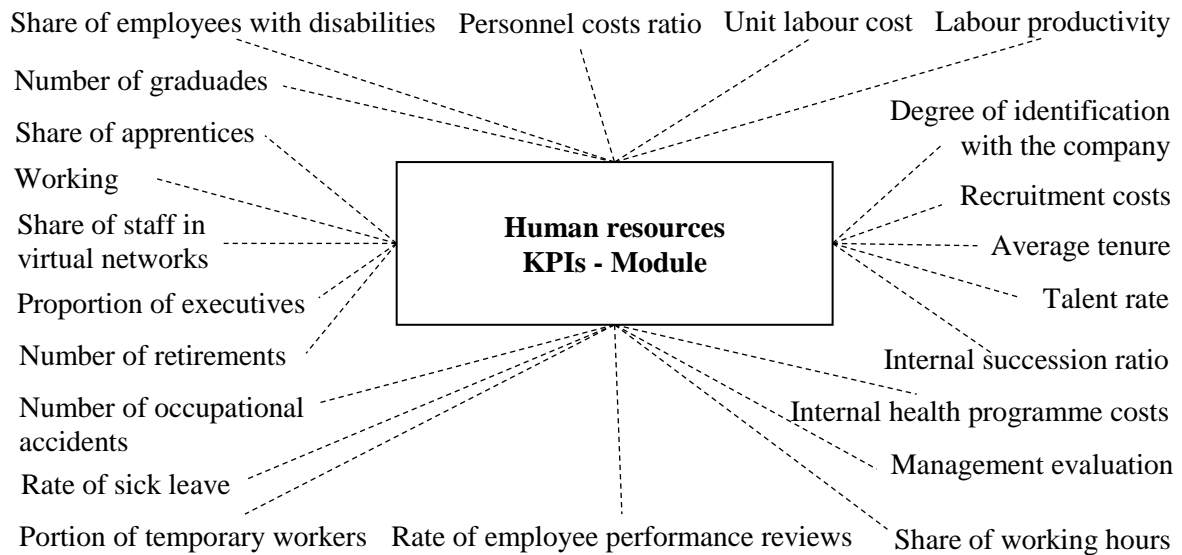


Fig 6.13. Human resources KPIs – Module

Table 6.13. Significant elements associated to some of the Human resources KPIs – Module components		
Defining elements		Unit of measurement
RSL	Rate of sick leave	%
SLT	Total of sick leave time	hours/week or month or ...
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 employees performance reviews	No./ month or quarter or ...
TSN	Total staff number of the department (division, enterprise)	

$$\left. \begin{aligned} \text{KPI}_1: \text{RSL} &= 100 * \text{SLT}/\text{WT} \\ \text{KPI}_2: \text{PTW} &= 100 * \text{NTW}/\text{TS} \\ &\dots \\ \text{KPI}_n: \text{REPR} &= 100 * \text{NEPR}/\text{TSN} \end{aligned} \right\} \quad (6.13)$$

### 6.2.14. KPIs – Module for innovation

Innovation plays an increasingly important role in the corporate culture. The ongoing expansion of the services offered and the integration of the entire human capital of the company is essential.



### 6.3. Remarks on the KPIs – Modules use

Based on the findings from the literature review (see chapters 1 - 3), the survey results (chapter 5) and the present development of the KPIs – Modules, it is possible to remark the followings.

#### KPIs – Modules for processes, production, quality, supply chain

Looking at the production-specific key performance indicators for the processes, production, quality, supply chain, there is minimal leeway for suppliers/sub-suppliers as this segment is particularly subject to a range of prescribed customer requirements.

#### KPIs – Module for financials

By this reduction to the essential financial ratios, the control of the enterprise is substantially facilitated especially for small and medium-sized enterprises and suppliers. Until now, too many financial ratios have often been collected and used. This led to an information overload for the targeted audience.

#### KPIs – Module for sales

When considering the sales and market key performance indicators, it is clear that there is a strong connection between the company aims, the sales targets and hence also the associated key performance indicator requirements in the companies. This suggests a high level of quality in the use of targets and requirements within the industry.

#### KPIs - Module for customers

Indicators for customers and acquisition 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.

#### KPIs – Modules for acquisition, offers, orders, price

A costly sales system based on customer acquisition should quickly be replaced by efficient sales based on attaining orders. It is therefore important to implement a corresponding paradigm shift in sales. Sales employees must learn that their work has to be evaluated in accordance with new criteria.

#### KPIs – Module for marketing

A systematic approach in marketing with the integral use of marketing key performance indicators is often not the norm. Of course, conventional parameters such as market share, market volume and market potential are frequently used.

#### KPIs – Modules for human resources, innovation

Recruiting, employee support and development, staff training, employee satisfaction and much more fall under the remit of HR management. Unlike in larger companies, this area is often neglected somewhat in small and medium-sized companies.

## **Chapter 7. Development of key performance indicators models for SMEs in the production industry**

The development of key performance indicators models for SMEs in the production industry, including the author's published elements [T04, T05, T06, T07], is as follows.

The key performance indicators model, KPIs – Model, is used, in this thesis, as a group of individual KPIs from the various modules.

These model developments enable small and medium-sized companies in the production industry to implement a favourable, lean key performance indicator system in their companies in the future. Attention is paid to a simple and cost-effective application for small and medium-sized enterprises in the production industry.

The KPIs - Models are designed in such a way that SMEs can directly use them.

In order to collect and process the necessary data for calculation of the associated KPIs – Models, each company can define and implement a conventional or digital system in compliance with its resources.

Adjusting the models to specific industries and using other key performance indicators described in the platforms is possible and indeed practical.

It is feasible to adapt the key performance indicators used in the theoretical models to the individual needs of the company at any time.

Key performance indicators of different areas of the company are generated meaningfully from the defined modules (see chapter 6). The models are created from these KPIs on the basis of the survey study results (see chapter 5).

The models further presented are exemplary for application in the production industry by micro-enterprises, start-ups, small and medium-sized enterprises.

A case study has been performed in order to exemplify the way of KPIs - Models development in paper industry, as part of production industry.

### **7.1. Level 1 KPIs – Models**

The Level 1 KPIs – Models are suitable for micro-enterprises, start-ups and small companies.

The envisaged models support the company to efficiently obtain a representation of the actual situation.

The effort required to survey and implement such of level 1 KPIs – models in the company is low. A number of important findings for controlling the relevant business areas are thereby enabled.

The Level 1 KPIs – Models for processes & production, sales & marketing, and quality management are further presented, as exemplification.

#### **7.1.1. Level 1 KPIs – Model for processes and production**

The Level 1 KPIs – Model for processes and production is structured based on specific key performance indicators modules as presented in Fig. 7.1.

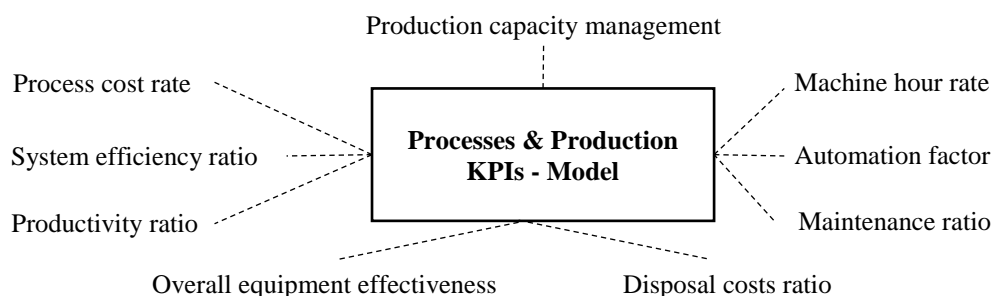


Fig. 7.1. Level 1 KPIs – Model for Processes & Production

Significant elements associated to some components of the Level 1 KPIs – Model for processes and production are as presented in Table 7.1. In addition, the analytical representation of the considered Level 1 KPIs – Model for processes and production is proposed as the group of eq. (7.1).

Table 7.1. Significant elements associated to some components of the  
Level 1 KPIs – Model for processes & production

Defining elements		Unit of measurement
PR	Productivity ratio	%
AO	Actual output	No./week or quarter or ...
NO	Nominal output	
SER	System efficiency ratio	%
EOT	Entire operation time	hours/quarter or year or ...
NOT	Net operation time	
...	...	...
DCR	Disposal costs ratio	%
DC	Disposal costs	euro/month or year or ...
TPC	Total production costs	
OEE	Overall equipment effectiveness	%
AF	Availability factor	See Table 6.2 and eq. (6.2)
QF	Quality factor	
CF	Capacity factor	

{

$$\begin{aligned} \text{KPI}_1: \text{PR} &= 100 * \text{AO}/\text{NO} \\ \text{KPI}_2: \text{SER} &= 100 * \text{EOT}/\text{NOT} \\ &\dots \\ \text{KPI}_8: \text{DCR} &= 100 * \text{DC}/\text{TPC} \\ \text{KPI}_9: \text{OEE} &= \text{AF} * \text{QF} * \text{CF} \end{aligned}$$

(7.1)

### 7.1.2. Level 1 KPIs – Model for sales and marketing

The Level 1 KPIs – Model for sales and marketing is shaped based on specific key performance indicators as presented in Fig. 7.2, Table 7.2 and eq.(7.2).

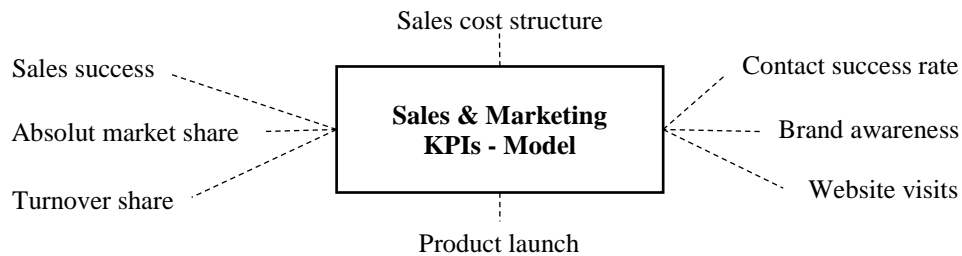


Fig. 7.2. Level 1 KPIs – Model for Sales & Marketing

Table 7.2. Significant elements associated to some components of  
the Level 1 KPIs – Model for sales & marketing

Defining elements		Unit of measurement
TS	Turnover share	%
TP	Turnover of a product	euro/month or quarter or ...
TT	Total turnover	
AMS	Absolut market share	%
NT	Net turnover	euro/quarter or year or ...
MV	Market volume	
...	...	...
PL	Product launch	%
TEP	Turnover about early product entry	euro/month or year or ...
CEP	Costs about early product entry	

{

$$\begin{aligned} \text{KPI}_1: \text{TS} &= 100 * \text{TP}/\text{TT} \\ \text{KPI}_2: \text{AMS} &= 100 * \text{NT}/\text{MV} \\ &\dots \\ \text{KPI}_e: \text{PL} &= 100 * \text{TEP}/\text{CEP} \end{aligned}$$

(7.2)

### 7.1.3. Level 1 KPIs – Model for quality management

A KPIs - Model of quality management is used to analyse the company's current situation and future development. The aim is to visualise and interpret internal business processes and activities. This includes business processes, business results, KPIs information about financials, quality, supply chain, customers, suppliers, employees. Finally quality management gives an objective output about the functionality of company methods and processes.

The Level 1 KPIs – Model for quality management is developed based on specific key performance indicators as presented in Fig. 7.3.

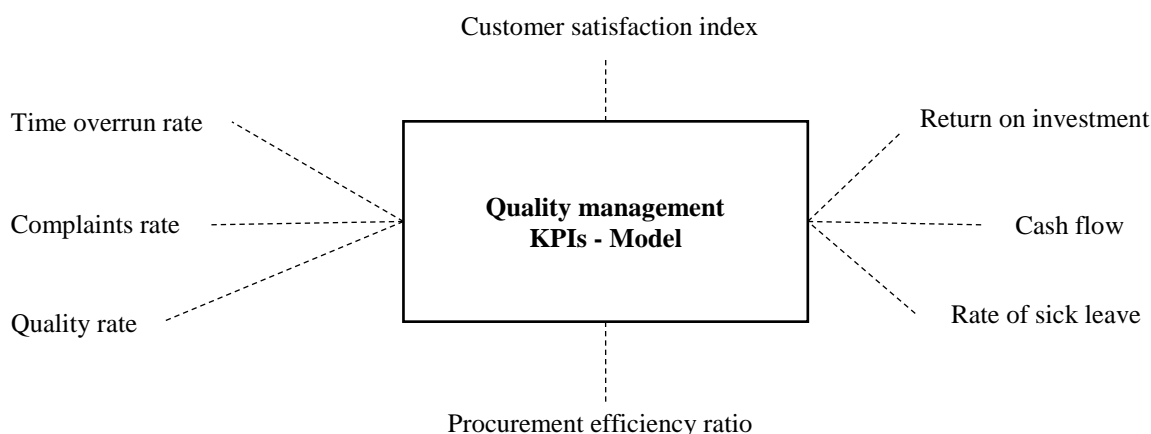


Fig. 7.3. Level 1 KPIs – Model for quality management

Significant elements associated to some components of the Level 1 KPIs – Model for quality management are as presented in Table 7.3. In addition, the analytical representation of the considered Level 1 KPIs – Model for quality management is proposed as the group of eq. (7.3).

Table 7.3. Significant elements associated to some components of the  
Level 1 KPIs – Model for quality management

Defining elements		Unit of measurement
QR	Quality rate	%
DQ	Defect quantity	No./month or quarter or ...
FQ	Free quantity	
TQP	Total quantity produced	
CR	Complaints rate	%
RP	Number of returned products	No./quarter or year or ...
TSP	Total number of sold products	
...	...	...
PER	Procurement efficiency ratio	%
CPD	Costs of the procurement department	euro/month or year or ...
OQ	Ordered quantity	
AP	Acquisition price	

{

$$\begin{aligned} \text{KPI}_1: \text{QR} &= 100 * \frac{\text{DQ} - \text{FQ}}{\text{TQP}} \\ \text{KPI}_2: \text{CR} &= 100 * \text{RP}/\text{TSP} \\ &\dots \\ \text{KPI}_e: \text{PER} &= 100 * \frac{\text{CPD}}{\text{OQ} * \text{AP}} \end{aligned}$$

(7.3)

## 7.2. Level 2 KPIs – Models

The Level 2 KPIs – Models are recommended for SMEs already established in the market. A Level 2 KPIs - Model builds on the correspondent Level 1 KPIs – Model. In addition, the Level 2 KPI - Model can include new KPIs. The effort required to survey and implement the key performance indicators is quite manageable for SMEs.

### 7.2.1. Level 2 KPIs – Model for processes and production

The Level 2 KPIs – Model for processes and production is structured based on specific KPIs as presented in Fig. 7.4.

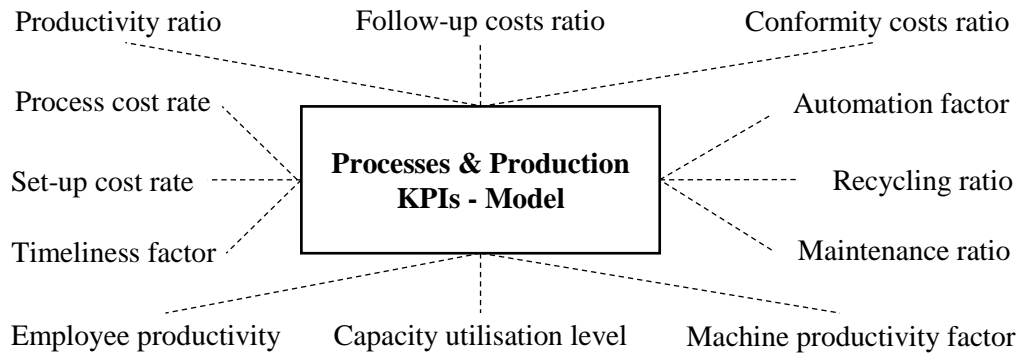


Fig. 7.4. Level 2 KPIs – Model for Processes & Production

### 7.2.2. Level 2 KPIs – Model for sales and marketing

The Level 2 KPIs – Model for sales and marketing is structured based on specific KPIs.

### 7.2.3. Level 2 KPIs – Model for quality management

The Level 2 KPIs – Model for quality management is developed based on specific KPIs.

## 7.3. Level 3 KPIs – Models

A Level 3 KPIs – Models provide the general management/ head of division or department with a highly effective controlling tool for all business processes.

### 7.3.1. Level 3 KPIs – Model for processes and production

The Level 3 KPIs – Model for processes and production is structured based on specific KPIs.

### 7.3.2. Level 3 KPIs – Model for sales and marketing

The Level 3 KPIs – Model for sales and marketing is shaped based on specific KPIs.

### 7.3.3. Level 3 KPIs – Model for quality management

The Level 3 KPIs – Model for quality management is developed based on specific KPIs as presented in Fig. 7.9, Table 7.9 and eq. (7.9).

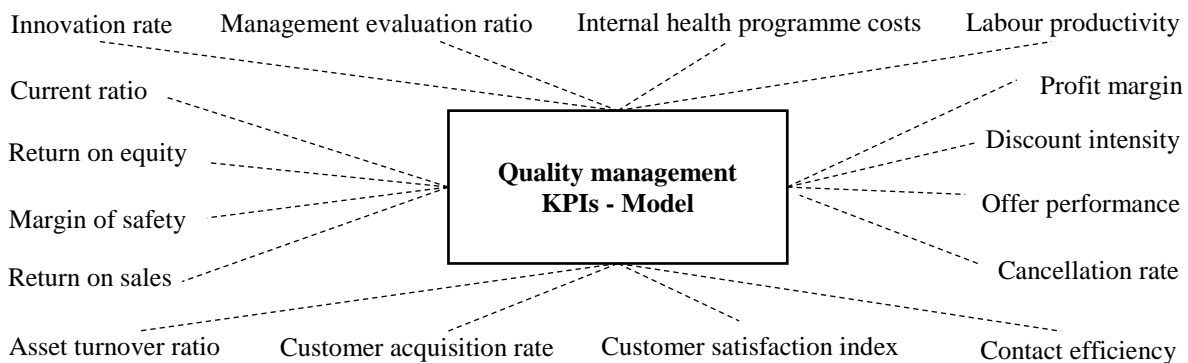


Fig. 7.9. Level 3 KPIs – Model for quality management

Table 7.9. Significant elements associated to components some of the Level 3 KPIs – Model for quality management

Defining elements		Unit of measurement
ATR	Asset turnover ratio	%
NS	Net sales	euro/month or quarter or ...
ATA	Average total assets	
ROS	Return on sales	%
NI	Net income	euro/quarter or year or ...
SL	Sales	
...	...	...
CAR	Customer acquisition rate	%
NNC	Number of new customers	No./quarter or year or ...
TNC	Total number of customers	

{

$$\begin{aligned} \text{KPI}_1: \text{ATR} &= 100 * \text{NS}/\text{ATA} \\ \text{KPI}_2: \text{ROS} &= 100 * \text{NI}/\text{SL} \\ &\dots \\ \text{KPI}_e: \text{CAR} &= 100 * \text{NNC}/\text{TNC} \end{aligned}$$

(7.9)

#### 7.4. Case study on Tier-1 and Tier-2 suppliers and sub-suppliers in paper industry

The present case study is referring to Tier-1 and Tier-2 suppliers and sub-suppliers in paper industry, as part of the deployed survey study (see chapter 5).

##### 7.4.1. Data detailed analysis

For a given topic/ question, the achievement of a *certain opportunity* in paper industry, at Tier-1 and Tier-2 suppliers and sub-suppliers,  $a(p)$ , is calculated as

$$a(p) = 100 * b(p) / c(p), \text{ in } \% \quad (7.10)$$

where  $b(p)$  and  $c(p)$  are the number of answers given by the paper industry companies to the considered opportunity, and to the associated topic/ question (all opportunities), respectively.

The results type of  $a(p)$  associated to paper industry, rel. (7.10), have been compared with the correspondent results type  $a(w)$  associated to whole survey, rel. (5.2), through the deviation (difference),  $d(p,w)$ ,

$$d(p,w) = a(p) - a(w) \quad (7.11)$$

For a simple presentation, the values of  $d(p,w)$  calculated by rel. (7.11) were rounded up or down to the closest integer number.

The values of the deviation  $|d(p,w)|$  were classified into four categories: very strong, strong, weak, none, i.e.,

- very strong, if predominantly  $|d(p,w)|$  was greater than 20%;
- strong, if predominantly  $|d(p,w)|$  was between 10% and 20%;
- weak, if predominantly  $|d(p,w)|$  was between 5% and 10%;
- none, if predominantly  $|d(p,w)|$  was less than 5%.

Based on the above data, the following elements can be stressed.

- In the question of the meaningfulness of the use of key performance indicators and in the disclosure of the reasons for this, no significant deviations could be found.

- Massive differences were noticeable in the linking of KPIs within the company/company divisions. Here there was a change of + 21 % for the answer ‘yes’, - 35 % for the answer ‘no’, and + 13 % for the answer ‘partly’.
- There are strong differences in KPIs communication. 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 direct benefit when using KPIs for the company was assessed in the same way as in the overall study. However, there were differences in the individual, personal perception of benefit. Feedback here was up to - 6 % for quality improvement and process optimisation.
- Tier-1 suppliers and Tier-2 suppliers of the paper industry decided that KPIs are a greater benefit than cost (+ 20 % for answer ‘agree completely’ and + 9 % for answer ‘agree largely’). KPIs are an efficient means of assessing the enterprise/ department (+ 16 % for answer ‘agree largely’) and KPIs offer clear information (+ 26 % for answer ‘agree completely’, - 23 % for answer ‘agree largely’, + 11 % for answer ‘agree partially’ and - 14 % for the rest of answers).
- The personal statement about the use of KPI knowledge for everyday work, brought a strong deviation. A plus of 11% for answer ‘agree completely’, - 13% for the answers ‘do not agree’ and ‘do rather not agree’ were given.
- The results evaluation of KPIs in sales is showing, that Tier-1 suppliers and Tier-2 suppliers have a stronger (+ 12 %) use of sales controlling as a strategic tool in their enterprises as compared to the whole production industry. Similarly is the result about a regularly, systematically and holistically use of sales controlling across of all distribution levels.
- There was a slight shift in the sales success KPIs. ‘Sales profit margin’ (+ 6%) and ‘customer result share’ (+ 7%) performed slightly better. By contrast, the KPIs ‘sales success’ (- 8%) and ‘order profit margin’ (- 6%) lost some of their importance.
- Very interesting is the result about the use of KPIs for customer contact and customer support. 33 % of the Tier-1 suppliers and Tier-2 suppliers are not using anyone of the possible KPIs. This shows a deviation of + 15 %.
- The strong use of the ‘customer satisfaction index’ (+ 20 %) of suppliers and sub-suppliers is remarkable. It clearly shows that Tier-1 suppliers and Tier-2 suppliers focus on customer needs in many ways. This is a clear strength of these companies.
- The results analysis of KPIs in marketing is showing a stronger use (+ 15 %).
- There is a positive deviation to the industry results for the marketing KPIs and the purchase power ‘market potential’ (+ 15 %) and ‘market volume’ (+ 5 %) given. ‘Market share and ‘name recognition’ are a bit weaker (- 5 %).
- A very strong deviation was given to the question about the use of KPIs for customer performance. ‘Customer satisfaction’ is in top lead (+ 30 %).
- When assessing the quality of products and services, slight differences can be seen in the data analysis. What is also striking here is, that the number of suppliers and sub-suppliers of the paper industry who do not collect any relevant figures is higher than in the overall study result (+ 12 %). The remaining KPIs are basically at a similar level.
- The feedback about the use of KPIs to measure the internet/ online marketing success is very interesting. The result is dramatically different to the whole industry result. 33 % of the Tier-1 suppliers and Tier-2 suppliers in the paper industry have said they are not using any internet/ online marketing KPIs (+ 19 %).
- 38 % of the suppliers and sub-suppliers of paper industry have noticed an increase about the image of the company in the last two years. Negative is that in sum more than a half of the collected enterprises are seeing no improvement by using marketing KPIs.

#### 7.4.2. Development of KPIs – Models

Taking into account the results of the above analysis on Tier-1 and Tier-2 suppliers and sub-suppliers in paper industry, two KPIs – Models have been developed.

##### Development of KPIs – Model A

The KPIs – Model A is representing processes, production, financials, quality, supply chain, human resources, innovation associated to Tier-1 and Tier-2 suppliers and sub-suppliers in paper industry (Fig. 7.10).

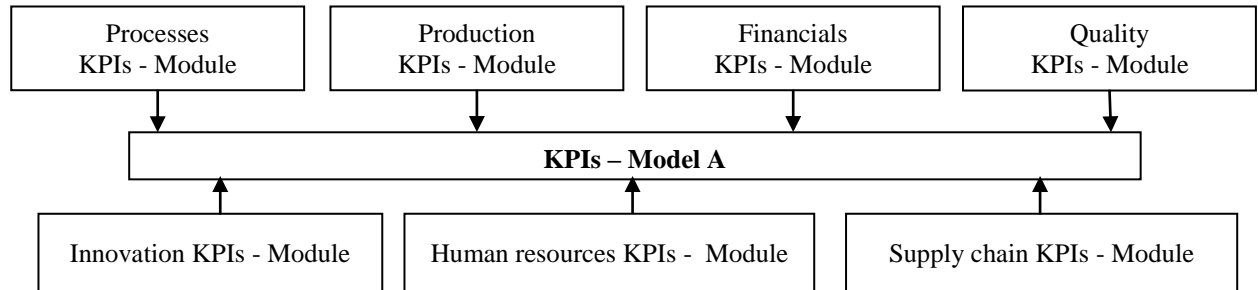


Fig. 7.10. KPIs – Modules for KPIs - Model A development

An example of KPIs – Model A 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 (see chapter 6) as presented in Fig. 7.11., Table 7.12 and eq. (7.12).

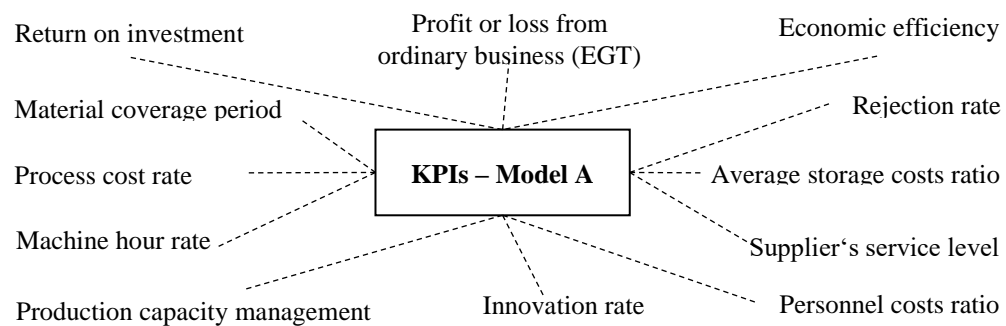


Fig. 7.11. KPIs – Model A

Table 7.12. Significant elements associated to some components of the KPIs – Model A

Defining elements		Unit of measurement
PCM	Production capacity management	%
EA	Effective availability	hours/week or month or ...
TOT	Total operation time	
MHR	Machine hour rate	%
RM	Related machine costs	euro/month or quarter ...
MR	Total machine runtime costs	
...	...	...
IR	Innovation rate	%
TSI	Turnover share of innovations	euro/quarter or quarter or ...
TNT	Total net turnover	

$$\left\{ \begin{array}{l} KPI_1: PCM = 100 * EA/TOT \\ KPI_2: MHR = 100 * RM/MR \\ \dots \\ KPI_c: IR = 100 * TSI/TNT \end{array} \right\} \quad (7.12)$$

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

A simple reporting document for information and continuous review, conventional or in digital system, is proposed as presented in Fig. 7.12.



Company		Status report KPIs – Model A		Date: DD.MM.YYYY	
Department: Prepared by: Approved by:		Review period: MM – MM		General status: <input type="checkbox"/> On track <input type="checkbox"/> Potential risks <input type="checkbox"/> Roadblocks	
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 (EGT)				
7)	Economic efficiency				
8)	Rejection rate				
9)	Average storage costs ratio				
...	...				
No.	Reasons for deviations				
...	....				
No.	Further action			Due date	Responsible
...	....				
Remarks					
Status report author:		Recipients:		Date of next status report: DD.MM.YYYY	

Fig. 7.12. Status report for KPIs – Model A

Development of KPIs – Model B

The KPIs – Model B is representing sales, customers, acquisition, offers, orders, price, marketing associated to Tier-1 and Tier-2 suppliers and sub-suppliers in paper industr (Fig. 7.13).

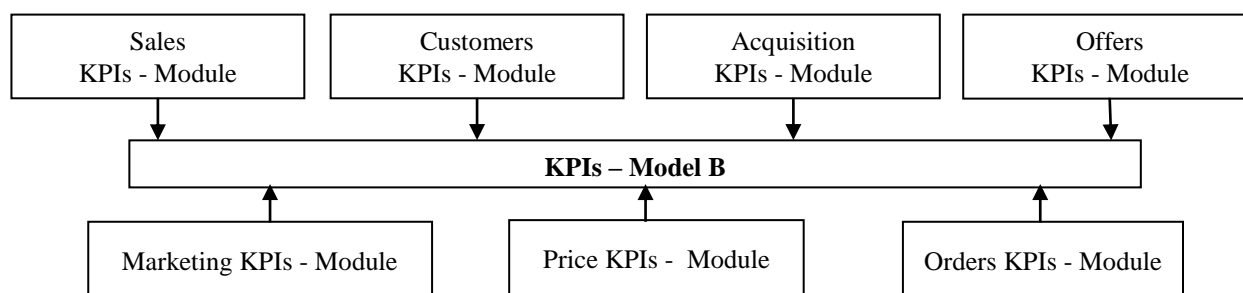


Fig. 7.13. KPIs – Modules for KPIs - Model B development

An example of KPIs – Model B has been developed as a mix of KPIs selected from KPIs – Modules associated to sales, customers, acquisition, offers, orders, price, marketing key performance indicators (see chapter 6), similar to that for previous KPIs KPIs – Model A.

Also, a simple reporting document for information and continuous review, conventional or in digital system, is proposed similar to that for previous KPIs – Model A.

## **Chapter 8. Final conclusions and main contributions to the development on modules, models and use of key performance indicators for small and medium-sized enterprises in the production industry**

(1) From the analysis of the actual state of the art on key performance indicator systems in production industry, important conclusions have been drawn, as they are presented in the Chapter 3.

(2) Based on the data and conclusions drawn from the present state of the art analysis, it has been assessed to be of perspective, for development on modelling of key performance indicators, KPIs, for small and medium-sized enterprises, SMEs, in the production industry, the research and development directions as presented in § 4.1.

(3) According to the present state of the art and the research and development directions, it has been determined as main objective of the foremost research and development doctoral activity (see, also, § 4.2): *development of useful proper modules and models of KPIs for SMEs in production industry.*

(4) The representative conclusions of the foremost research and development doctoral activity, to achieve its main objective, are as follows.

- The problem of the use of KPIs in the production industry, especially among SMEs and industrial suppliers, still exists and is of severity.
- A scientific survey study has been designed concerning the advantages and risks of KPIs use by the SMEs in production industry, for quality and profit in a sustainable development process (see § 4.3.1, 4.3.2).
- The designed scientific survey study, carried out in the DACH region (Germany, Austria and Switzerland/ German-speaking Europe) in the production industry, reveals important states, as follows (see chapter 5).
- Almost two thirds of respondents confirmed that they are not subject to customer requirements about the use of KPIs.
- About 65 % of respondents stated that a degree of interface coordination and hence also interdepartmental use of KPIs takes place either partly or full.
- All surveyed companies consider the use of KPIs generally as useful, and 90% of them currently use them, because the results include real benefits.
- The significance and usefulness of KPIs for future company controlling is certainly considered to be in a critical state.
- In the personal assessment of the benefits of KPIs, both quality improvement and process optimisation drop by 6 % compared to the whole production industry in the deployed survey.
- About 88.5 % of participating companies regard sales controlling as strategically important for their company.
- Continuous customer contact is undoubtedly perceived as one of the most important controlling measures for successful sales.
- The use of KPIs is rather limited both for general customer contact and customer support, as well as in offer and acquisition processes.
- In general, the companies determine their actual sales success predominantly using the product profit margin.
- Larger companies tend to concentrate on innovation leadership and sales support, whereas SMEs prefer to drive the acquisition of leads as well as product and service quality.

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- The degree of automation for sales KPIs collection varies significantly.
  - Customer satisfaction is cited as the most important key performance indicator for evaluating customer performance.
  - The suppliers and sub-suppliers of the production industry attach great importance to customer orientation and the fulfilment of customer needs. It is noteworthy that despite this clear commitment to the customer, almost one fifth of those surveyed did not collect any KPIs in this respect.
  - Surprising was the result concerning the KPI communication and its used systems. Oral communication in SMEs is significantly stronger than in the overall industry assessment.
  - Companies that engage in digital/ online marketing state that the use of these internet/ online key performance indicators has brought about a significant improvement in the years.
  - None of the analysed sectors of the production industries currently has a clearly and unequivocally defined customer requirement with regard to the use of a specific key performance indicator system.
  - The importance of KPIs for decision making, controlling, optimisation and continual process improvement is emphasised in the companies.
  - For a limited number of KPIs, suppliers/ sub-suppliers of the production industry are subject to a binding (contractually agreed) customer requirement.
    - A series of KPI - Modules have been developed, and the following elements are emphasised (see Chapter 6).
  - A KPIs – Module is considered a group of KPIs with a meaningful that can be assigned to a certain topic.
  - KPIs – Modules are presented exemplary for a possible application in the production industry by SMEs.
  - The main series of the KPIs - Module has been developed for processes, production, financials, quality, supply chain, sales, customers, acquisition, offers, orders, price, marketing, human resources and innovation.
  - Significant elements associated to the KPIs – Modules components are presented in tables and equations.
  - For the specific KPIs for processes, production, quality, supply chain, there is minimal leeway for suppliers/ sub-suppliers. This is explained by the prescribed quality and documentation controls, and the aim to improve collaboration between the companies involved.
  - By reduction to the essential financial ratios, the control of the enterprise is substantially facilitated especially for SMEs and suppliers.
  - Considering the KPIs sales and market, it is clear that there is a strong connection between the company aims, the sales targets and hence also the associated key performance indicator requirements in the companies.
  - For the controlling of sales among suppliers/ sub-suppliers, a concentration on key performance indicators that analyse sales costs, time expenditure and internal expenses is sensible.
  - Communication with the customer and the public on multiple digital levels represents a key challenge of the future.
  - More transparently and objectively the value as well as performance of an employee can be analysed and assessed.
  - Intelligent key performance indicator 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.

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- 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 order to ensure long-term business success, it is essential that SMEs engage more in KPIs use.
    - A series of KPI - Models have been developed, and the following elements are emphasised (see sub-chapters 7.1, 7.2, 7.3).
  - A KPIs – Model is considered as a group of individual KPIs from various modules of the production industry.
  - The KPIs – Models have been created from key performance indicators of different areas of the company, generated meaningfully from the defined modules. on the basis of the survey study results.
  - The KPIs – Models have been developed on three levels: the Level 1 KPIs – Models - for micro-enterprises, start-ups and small companies; the Level 2 KPIs – Models - recommended for SMEs present in the market; the Level 3 KPIs – Models – to sustain the general management for business processes.
  - KPIs – Models have been exemplified for processes and production, sales and marketing, etc. for application in the production industry.
  - Significant elements associated to the KPIs – Models components are presented in tables and equations.
    - A case study was unrolled referring to Tier-1 and Tier-2 suppliers and sub-suppliers in paper industry, as part of the deployed survey study, and the relevant remarks are as follows (see sub-chapter 7.4).
  - The results associated to the Tier-1 and Tier-2 suppliers from paper industry present diverse deviations with respect to the correspondent results from whole production industry. For instance, suppliers to the paper industry rated hurdles related to the IT system and organizational challenges +12 % higher, while the expenditure concerns was valued 10 % lower (-10%).
  - Generally, the Tier-1 and Tier-2 suppliers in the paper industry are much more convinced about the benefits of key performance indicators than the industry as a whole.
  - A KPIs – Model A has been developed as a mix of KPIs selected from KPIs – Modules representing processes, production, financials, quality, supply chain, human resources, innovation associated to Tier-1 and Tier-2 suppliers and sub-suppliers in paper industry.
- Also, a KPIs – Model B has been developed as a mix of KPIs selected from KPIs – Modules representing sales, customers, acquisition, offers, orders, price, marketing associated to Tier-1 and Tier-2 suppliers and sub-suppliers in paper industry.
- For each KPIs – Model, a simple type of reporting document for information and continuous review, conventional or in digital system, has been proposed, with the role for periodic reports presentation, to support the continuous improvement and optimization of the entrepreneurial value creation and its process, etc.
- These KPIs – Model A and KPIs – Model B can be implemented quickly, cost-effectively and easily at suppliers and sub-suppliers in the paper industry.
- The important hurdles in introducing KPIs were identified as organisational challenges, as well as the general fear of total cost for the company.
  - Tier-1 suppliers and Tier-2 suppliers are much more convinced that there are clear customer requirements, even they are concentrating primarily on the KPIs quality assurance and logistics.

- In comparison to the overall industrial results, Tier-1 and Tier-2 suppliers use more intensively sales controlling as a regularly, systematically, and holistically tool across of all distribution levels, have a stronger use of marketing KPIs, but they have to catch up in online marketing.

- Tier-1 suppliers and Tier-2 suppliers can act much more efficiently than large organizational units in terms of linking specialist departments and KPIs due to their company specifications and basic structure.

(5) Accordingly with the achievement of the main objective of the research and development doctoral activity, the present PhD thesis brings several contributions, of which the most important are as follows.

- The design, unrolling and results analysis of a scientific survey study concerning the advantages and risks of key performance indicators use by the small and medium-sized enterprises in production industry, for quality and profit in a sustainable development process.
- Development of a main series of key performance indicators modules, KPIs – Modules, as reference entities for small and medium-sized enterprises in the production industry, representing processes, production, financials, quality, supply chain, sales, customers, acquisition, offers, orders, price, marketing, human resources and innovation.
- Development of a main series of key performance indicators models, KPIs – Models, as reference entities for small and medium-sized enterprises in the production industry, representing processes and production, sales and marketing, etc., on three levels: the Level 1 KPIs – Models - for micro-enterprises, start-ups and small companies; the Level 2 KPIs – Models - recommended for SMEs present in the market; the Level 3 KPIs – Models – to sustain the general management for business processes.
- Configuring and analysing a case study referring to Tier-1 and Tier-2 suppliers and sub-suppliers in paper industry, with the emphasis of the specific features.
- Defining the key performance indicators, KPIs – Modules and KPIs – Models through significant elements in tables and equations.

\* \* \*

The present PhD thesis, by problematic, approach and results, develops a series of important theoretical and applicative elements on key performance indicators associated to small and medium-sized enterprises in the production industry, to support quality and profit in a sustainable development process.

The *scientific importance* of this thesis is sustained by its contributions to the development of key performance indicators modules and models, defined through conceptual elements and equations, for small and medium-sized enterprises in the production industry.

The *practical importance* of this thesis consists in the fact that the achieved key performance indicators modules and models, as well as the results of the designed and unrolled survey study are useful, by case, to individuals, students, academic staff, industry specialists, various educational and business organisations, to increase the awareness on the importance of the development and implementation of key performance indicators.

As *potential perspective*, the problematics of development and implementation of proper key performance indicators modules and models, through conventional or digital systems in compliance with companies specific profile and resources, requires a complex, continuous and profound research and applicative development activity.

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## Annex 1. Study Questionnaire

### No. Question/ topic and answer opportunities

1. Do you consider the application of performance indicators/ key performance systems to be useful?
  - Yes
  - No
2. Why do you consider the application of KPIs to not be useful?
  - See no actual use
  - Have no knowledge in the topic
  - It is too complicated in the conversion/ expenditure is too high
  - Has brought to the enterprise no demonstrable success
  - Others: \_\_\_\_\_
3. Do you plan in the near future (< 2 years) to introduce KPIs/ KPI systems in your enterprise?
  - Yes
  - No
4. In which areas of your enterprise will you introduce KPIs/ KPI systems?
  - General Management (whole enterprise consideration)
  - Sales/ Marketing
  - Manufacturing/ Manufacturing Engineering
  - Purchase Department
  - Logistics/ Supply Chain
  - Engineering/ Research and Development
  - Quality Assurance
  - IT
  - Human Resource Management
  - After Sales
  - Controlling/ Accounting
  - Administration
  - Others: \_\_\_\_\_
5. Why do you consider the application of KPIs to be useful?
  - Are helpful by the reaching of the enterprise aims
  - Support the continuous improvement process
  - Are impulse for changes and adaptations
  - Are clear control tools (controlling)
  - Allow an objective approach
  - If decisions help to hit
  - Others: \_\_\_\_\_
6. What are KPIs/ KPI systems well suited to, in your opinion?
  - To the cost control
  - To the process analysis
  - To the target reaching
  - For adequate reimbursement
  - To the identification of improvement potentials
  - To the benchmark (internal/ external)
  - Others: \_\_\_\_\_
- 7..What are the challenges posed by the introduction of KPIs/ KPI systems, in your opinion?
  - IT system conditioned hurdles
  - Organisational challenges
  - Enterprise political hurdles
  - Missing Know how
  - Fear of the expenditure
  - Others: \_\_\_\_\_
8. Do you use KPIs/ KPI systems in your enterprise?
  - Yes
  - No
9. Which departments typically use KPIs/ KPI systems in your enterprise?
  - General Management
  - Sales/ Marketing
  - Manufacturing/ Manufacturing Engineering
  - Purchase Department
  - Logistics/ Supply Chain
  - Engineering/ Research and Development
  - Quality Assurance
  - IT
  - Human Resource Management
  - After Sales
  - Controlling/ Accounting
  - Administration
  - Others: \_\_\_\_\_
10. Which categories of KPIs do you currently use in your enterprise?
  - Economic performance indicators (economic, efficiency, ROI, yield, ...)
  - Manufacturing performance indicators (productiveness, operating power, ...)
  - Process performance indicators (team development, cleanness, ...)
  - Logistics performance indicators (stock value, ability of delivery, ...)
  - Quality performance indicators (committee rate, back instruction rate, ...)
  - Customer/ Supplier performance indicators (objection, loyalty of delivery, ...)
  - Environmental performance indicators (energy consumption, waste industry, ...)
  - Legal performance indicators (accident frequency, appointment values, ...)
11. Are the KPIs/ KPI systems in use linked together (between departments) in your enterprise?
  - Yes
  - No
  - Others: \_\_\_\_\_
12. How do you communicate KPI/ KPI system knowledge?
  - Are published as an online report (internal intranet, ...)
  - Are proceeded as a classical report and dispatched by mail or e-Mail
  - Are given orally in meetings/ talks
  - Others: \_\_\_\_\_
13. Does the use of KPIs/ KPI systems produce a direct benefit for your enterprise?
  - Yes
  - No
14. What benefits do you achieve?
  - Enterprise or department results improve Process optimisation (improvement of expiries and communication)
  - Better aim reaching
  - Higher employee satisfaction
  - Increase of customer/ supplier satisfaction
  - Cost savings
  - Increase of the quality
  - Others: \_\_\_\_\_

15. In your opinion, what are the reasons for the lack of benefit provided by KPIs/ KPI systems for your enterprise/ department?
- The used KPIs/ KPI systems are topically inexpedient
  - The KPIs/ KPI systems default or their aim reaching is unrealistic
  - The survey for the KPIs evaluation falls short
  - The aim and the sense of the KPI/ KPI systems is not communicated enough
  - It was seen not enough to the integration of the department / the employees
  - Others: \_\_\_\_\_
16. Is it a customer requirement to use KPIs/ KPI systems in your enterprise?
- Yes
  - No
17. Which KPIs are you required to use for your customers?
- Economic KPIs (economic efficiency, ...)
  - Price/ Distribution achievements (turnover rate, customer satisfaction, ...)
  - Market/ Marketing KPIs (absolute or relative market share, image, ...)
  - Process/ Manufacturing KPIs (capacity, ...)
  - Quality assurance KPIs (repair rate, defects, ...)
  - Logistics/ Supply Chain KPIs (appointment loyalty, faultily delivered products, ...)
  - HR-Management KPIs (personnel expenditure, ...)
  - Innovation/ Engineering development KPIs (innovation rate, patents, ...)
  - Others: \_\_\_\_\_
18. Do you know why your customer requires you to use KPIs/ KPI systems?
- Yes
  - No
19. What are the reasons given by your customer?
- To fulfil their customer demands (contract defaults, ...)
  - For the qualitative assurance
  - To the risk minimisation
  - For documentation purposes
  - For the process improvement in the cooperation between customer and supplier
  - No idea
  - Others: \_\_\_\_\_
20. Are there any requirements placed on your suppliers to use KPIs/ KPI systems?
- Yes
  - No
21. What are your reasons for placing these demands on your suppliers/ sub-suppliers?
- To fulfil their customer demands (contract defaults, ...)
  - For the qualitative assurance
  - To the risk minimisation
  - For documentation purposes
  - For the process improvement in the cooperation between customer and supplier
  - No idea
  - Others: \_\_\_\_\_
22. Which KPIs are your suppliers/ sub-suppliers required to use?
- Economic KPIs (economic efficiency, profitability, ...)
  - Price/ Distribution achievements (turnover rate, ...)
  - Market/ Marketing KPIs (absolute market share, image, ...)
  - Process/ Manufacturing KPIs (capacity, ...)
  - Quality assurance KPIs (repair rate, defects, ...)
  - Logistics/ Supply Chain KPIs (appointment loyalty, ...)
  - HR-Management KPIs (personnel expenditure, ...)
  - Innovation/ Engineering development KPIs (patents, ...)
  - Others: \_\_\_\_\_
23. Does sales controlling lead to strategic adjustments in your enterprise?
- Yes
  - No
24. Do you conduct sales controlling regularly, systematically and holistically across all distribution levels?
- Yes
  - No
25. Do you expect significant potential for improving results by means of systematic sales controlling?
- Yes
  - No
26. In which distribution levels do you not use sales controlling?
- Market observation and strategy level
  - Quotation level
  - Sales and negotiations level
  - Delivery level
  - After sales level
  - Others: \_\_\_\_\_
27. For which of the following do you apply knowledge of sales KPIs/ KPI systems?
- To the achievement of the distribution objectives (sales controlling)
  - To the controls of the distribution team or single distribution employees
  - In order to misjudge of improvement potentials in the sales process/ department
  - Others: \_\_\_\_\_
28. Are the sales KPIs/ KPI systems aligned with the company goals?
- Yes, completely
  - No, not at all
  - Partly
29. Which market KPIs do you use?
- Absolut or relative market share
  - Market potential
  - Market volume
  - Customer distribution
  - None
  - Others: \_\_\_\_\_
30. Which sales/ revenue KPIs do you use?
- Purchasing power index
  - Return on sales
  - Sales share
  - Sales potential
  - Revenue structure
  - Sales performance
  - Customer turnover rate
  - None
  - Others: \_\_\_\_\_
31. Which sales success KPIs do you use?
- Sales success/ Sales production
  - Sales profit margin
  - Product profit margin
  - Order profit margin
  - CLV (CLV / customer profit margin)
  - Customer result share
  - Structure of selling
  - Others: \_\_\_\_\_

32. Which customer contact and support KPIs do you use?
- Frequency of contact
  - Contact intensity
  - Contact success rate
  - Visit efficiency
  - Selling time range
  - Staff range
  - Average of profit contribution per travel day
  - Average of revenue contribution per travel day
  - None
  - Others: \_\_\_\_\_
33. Which offer and quotation KPIs do you use?
- Quotation rate
  - Proposal preparation
  - Incoming order value
  - Order receiving rate
  - Price implementation
  - Discount rate
  - Discount deduction rate
  - None
  - Others: \_\_\_\_\_
34. Which KPIs for complete order processing do you use?
- Customer complaint ratio
  - Cancellation rate
  - Exchange ratio
  - Delivery reliability
  - Customer payment loyalty
  - None
  - Others: \_\_\_\_\_
35. Which regular customer and new customer KPIs do you use?
- Customer satisfaction index
  - Customer loyalty
  - Proportion of regular customers
  - Regular customer share of revenue
  - New customer growth rate
  - New customer share of revenue
  - Customer loss rate
  - Customer winning back ration
  - None
  - Others: \_\_\_\_\_
36. Over which period do you collect KPIs?
- At least once a week
  - At least twice a week
  - At least once a month
  - At least once a quarter
  - Less than once a quarter
37. How do you collect KPIs?
- 100% by hand
  - 100% automated (IT-supported)
  - Both (by hand and semi-automatic)
38. How high is the share of automatically generated KPIs?
- Up to 10%
  - 10 – 30%
  - 30 – 50%
  - 50 – 75%
  - 75%
39. Do you use marketing KPIs/ KPI systems?
- Yes
  - No
40. Which marketing KPIs do you use for assessing the marketing and purchase power?
- Total efficiency of the marketing
  - Marketing productivity
  - Name recognition
  - Market share
  - Market potential
  - Market volume
  - Purchase power
  - Purchase intention
  - None
  - Others: \_\_\_\_\_
41. Which marketing KPIs do you use for assessing customer performance?
- Customer satisfaction
  - Customer loyalty
  - Customer retention
  - New customer acquisition
  - None
  - Others: \_\_\_\_\_ [A04]
42. Which marketing KPIs do you use for assessing products and offer attainment?
- New product introduction success rate
  - Flop rate for new product introduction
  - Cross selling product success rate
  - Product age ratio
  - None
  - Others: \_\_\_\_\_
43. Which marketing KPIs do you use for the internet/ online marketing?
- Visits/ website clicks (online)
  - Search engine ranking (online)
  - Social media (Instagram, Facebook, Twitter, ...)
  - None
  - Others: \_\_\_\_\_
44. Have you noticed in the recent past (< 2 years) an improvement in marketing KPIs?
- Yes
  - No
45. What has improved?
- The customer satisfaction/ customer connection
  - The image of the enterprise/ department
  - The enterprise result/ success
  - The market position/ market competitiveness
  - The public perception/ the standing in the population
  - No idea
  - Others: \_\_\_\_\_
46. What has worsened?
- The customer satisfaction/ customer connection
  - The image of the enterprise/ department
  - The enterprise result/ success
  - The market position/ market competitiveness
  - The public perception/ the standing in the population
  - No idea
  - Others: \_\_\_\_\_
47. KPIs/ KPI systems are a greater benefit than cost (rate the statement 1 to 5)
- Do not agree (1)
  - Agree completely (5)
48. KPIs/ KPI systems are an efficient means of assessing the enterprise/ department (rate the statement 1 to 5).
- Do not agree (1)
  - Agree completely (5)
49. KPIs/ KPI systems offer clear information (rate the statement 1 to 5).
- Do not agree (1)
  - Agree completely (5)

50. I use (or I would use) knowledge of KPIs/KPI systems for everyday work (rate the statement 1 to 5).

- Do not agree (1)
- Agree completely (5)

51. To which sector does your enterprise belong?

- Construction industry
- Mines and steel industry
- Chemical industry
- Electro and electronical industry
- Automotive industry
- Heat production industry
- Glass industry
- Timber and wood industry
- Industrial manufacturer of paper and cardboard products
- Metal technology industry
- Oil and gas industry
- Food industry/ food supplement industry
- Non-ferrous metals industry
- Paper industry
- Stone and ceramic industry
- Textile-, clothing-, shoe- and leather industry
- Others: \_\_\_\_\_ [A04]

52. Which position does your enterprise occupy in terms of OEM in manufacturing industry?

- OEM
- Tier-1 supplier
- Tier-2 supplier
- Service provider for OEMs or supplier of OEMs
- Others: \_\_\_\_\_

53. How high was the annual turnover of your enterprise in the last business year?

- Up to 10 Mio. EUR
- 10 – 25 Mio. EUR
- 25 – 50 Mio. EUR
- 50 – 100 Mio. EUR
- 100 Mio. EUR [G11]

54. How many people are employed in your enterprise?

- Up to 30 people
- 30 – 50 people
- 50 – 100 people
- 100 – 250 people
- 250 – 1000 people
- 1000 people [S09]

55. In which enterprise department do you work?

- General management
- Sales/ Marketing
- Manufacturing/ Manufacturing Engineering
- Purchase
- Logistics/ Supply Chain
- Engineering/ Research and Development
- Quality Assurance
- IT
- Human Resource Management
- After Sales
- Controlling/ Accounting
- Administration
- Others: \_\_\_\_\_

56. Which function do you hold in your enterprise?

- General Manager/ Executive Board
- Division Management/ Business Unit Management
- Department Management/ Group Management
- Staff position
- Others: \_\_\_\_\_

57. To which management level do you assign your functional area of responsibility?

- Strategically (long-term considerations, > 3 years)
- Tactically (mid-term considerations, 1 – 3 years)
- Operative (short-term considerations, up to 1 year)

58. How long have you held your current position?

- Up to 2 years
- 2 – 5 years
- 5 – 10 years
- 10 years [G07]

-//-