INTERNATIONAL STANDARD

ISO 18828-4

First edition
2018-06

Industrial automation systems and integration — Standardized procedures for production systems engineering —

Part 4: Key performance indicators (KPIs) in production planning processes

Systèmes d'automatisation industrielle et intégration — Procédures normalisées pour l'ingénierie des systèmes de production —

Partie 4: Indicateurs de performance clé dans les processus de planification de la production

Reference number
ISO 18828-4:2018(E)

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 4, *Industrial data*.

A list of all parts in the ISO 18828 series can be found on the ISO website.

Introduction

Ever-growing demands, such as increasing product and process complexity (recognizable by the high number of versions, short product lifecycles and greater time and cost pressures), define the key challenges faced by modern manufacturers. As a result, companies resort to ever-more sophisticated tools for managing complexity and improving transparency. Performance management systems provide aggregated quantitative depictions of the current situation via key performance indicators (KPIs), thereby creating the basis for improvement and decision-making processes. Consequently, the aim of using KPIs is to consistently analyse current production processes in order to control and manage them after start of production (SOP). In this way, KPIs provide a base of information for understanding and improving manufacturing performance.

NOTE 1 See for example ISO 22400.

Beyond the uniform set of core key indicators, many companies already successfully utilize performance management based on a self-defined, comprehensive range of measurable values. In this process, a target-oriented, company-specific interpretation of key indicators is often performed.

Considering the product development process in greater detail and taking into account the planning tasks before SOP, it is recognizable that the definition and establishment of standardized key indicators focuses on the phase after SOP. Figure 1 details the key tasks in this area based on the product lifecycle.

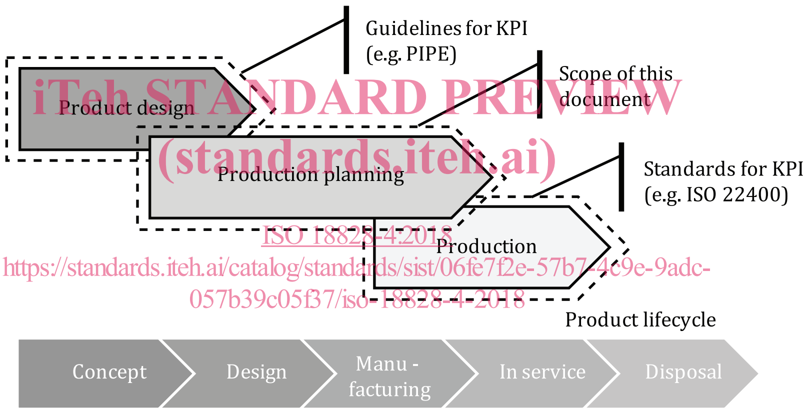

Figure 1 — Quantitative depiction of use of key performance indicators in product lifecycle

The range of process management indicators available in the production planning phase is quite small, as indirect planning tasks have rarely been recorded or managed up to this point. Consequently, there is no standardized set of basic key planning indicators before SOP.

The lack of adequate control parameters necessitates the development of a framework to monitor and improve production planning processes. Key indicators described in this document concern performance tracking of planning processes for engineering production systems.

NOTE 2 This is based on the planning disciplines and stage of development of the planning process in accordance with ISO 18828-2.

The KPIs for production planning generally help to advance the process of standardizing the quality of production process monitoring. The key indicators are abstracted in such a way that they can be consistently applied, according to their definition, in the various planning areas and, if properly adapted, in other areas as well. The key indicators by themselves cannot be used to measure process performance. They can only be set in relation to, and used for, the purposes of continuous comparison with process improvement if thresholds are defined and applied. Definition of the relevant thresholds therefore depends on the particular company. Regarding the production planning processes, it is necessary to pay more attention to the system boundaries of the analysis in order to ensure proper performance management. Key indicators often have a general trend, in terms of optimization taking place in general, or even a theoretical optimum existing. However, they require in particular an examination in relation to the company specifically and an application-based interpretation carried out previous to their utilization.

Industrial automation systems and integration — Standardized procedures for production systems engineering —

Part 4: Key performance indicators (KPIs) in production planning processes

1 Scope

This document specifies a set of key performance indicators in production planning, which allow comparison and monitoring of the production planning process in a standardized framework.

As a first step, the utilization of the KPIs is elaborated in order to organize the indicators in a multi-level system taking different ranges of the planning process into account. This development of a multi-level system represents the core of this document. The scope of the planning processes discussed in this document is limited to production planning for products in series production. Only tasks carried out within the production planning process are considered in this approach.

All key indicators presented are recommendations and can also be used in accordance with the general validity of the reference process from ISO 18828-2 and relate to the content described in this document.

2 Normative references

There are no normative references in this document.

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
key performance indicator
KPI
quantifiable level of achieving a critical objective

Note 1 to entry: The KPIs are derived directly from, or through an aggregation function of, physical measurements, data and/or other KPIs.

[SOURCE: ISO 22400-1:2014, 2.1.5]

3.1.2
area type rate
ATR
ratio of a specific area type in relation to total area

Note 1 to entry: Examples of specific area types are storage area and assembly area.

3.1.3
area utilization rate
AUR
ratio of required production area and allocated area

3.1.4
bottleneck information rate
BIR
amount of critical information in relation to all information, which causes delays if it is not available

3.1.5
container
general transport container

EXAMPLE Blister packs; lattice boxes; small parts containers.

3.1.6
container type rate
CTR
ratio of stored containers as a percentage of all containers used within the scope of the defined observation period

3.1.7
information type rate
ITR
ratio of a specific information type in relation to all information types taken together

Note 1 to entry: Examples of specific information types are missing information and used information.

3.1.8
information procurement time
t_{IPT}
time required to procure information while planner actively searches

3.1.9
information fulfilment rate
IFR
ratio of information provided by the actual process over the information required by the target process

3.1.10
information supply rate
ISR
ratio between the amount of existing information and required information for a planning task

3.1.11
information utilization rate
IUR
ratio of information used in relation to the appropriate amount of information available

Note 1 to entry: It is a measured value that describes the amount of available information used for the planning process.

3.1.12
information waiting time
t_{wait}
time spent waiting for information that is required for the planning process to continue

3.1.13
storage container rate
SCR
ratio of stored containers as a percentage of all containers used within the scope of the defined observation period

3.1.14
planning procedure alternatives
PPA
ratio of planning tasks that can be handled at the same time in relation to all tasks required

3.1.15
planning type rate
PTR
ratio of specific planning types to all planning types

Note 1 to entry: Examples of specific planning types are digital planning and workshop.

3.1.16
planning iteration number
PIN

number of iterations of a specific planning task

EXAMPLE Revision after a first successful performed planning task.

3.1.17

planning iteration rate

PIR
ratio of repeated planning tasks

EXAMPLE All tasks performed twice.

3.1.18
planning cycle time
t_{CT}
cycle time required for processing a particular planning task

3.1.19
planning work in progress
PWP
aggregated number of pending work tasks in the process scope

3.1.20
process detail level
PDL
number of sub-process steps planned for a process

EXAMPLE Specifying the description of an assembly process.

3.1.21
response time
t_{RT}
time between receipt of a planning request and start of planning operation

3.1.22
sub-process
process step that is part of a higher-level process

EXAMPLE Assembly and pre-/final assembly.

3.1.23
transport plan rate
TPR
ratio of the number of planned transportation plans to the number of all theoretically

3.1.24
time type rate
TTR
ratio of time types in relation to total working time

Note 1 to entry: Examples of time types are waiting and searching.

3.1.25
work plan rate
WPR
ratio of scheduled work plans to the work plans used in manufacturing operations

Note 1 to entry: An example of a scheduled work plan is for representative product variants.

3.1.26
work plan homogeneity level
WHL
measure for homogeneity or equal distribution in terms of duration of sub-process steps in relation to one another

3.2 Symbols and abbreviated terms

A_{all} total area

A_{alloc} allocated area

A_{ass} assembly area

A_{req} required area

A_{san} sanitary area

A_{sto} storage area

A_{x} set area

C_{all} total number of containers

C_{dim} number of containers; size: S/M/L

C_{ext} number of supplier containers

C_{int} number of internal containers

C_{spec} number of special containers

C_{stand} number of standard containers

C_{sto} number of containers stored

C_x	specific container type
D_{all}	all planning tasks required
D_{coop}	planning tasks performed in team/workshop etc
D_{dig}	planning tasks performed with digital planning support
D_i	number of pending planning tasks
D_{local}	planning tasks performed by the planner (team, department, etc.)
D_{real}	planning tasks actually implemented at the same time
D_{same}	planning tasks that can be handled at the same time
D_{stand}	planning tasks performed in line with standard workflow
D_x	planning tasks performed with specific planning type
I_{acc}	accepted information
I_{act}	information supplied from actual process
I_{all}	total of all information
I_{avail}	available information
I_{crit}	critical information
I_{dig}	digital information
I_{pri}	primary information
I_{req}	information required
I_{sec}	secondary information
I_{targ}	required information from target process
I_{used}	information used
I_x	specific information type
L_{TP}	level of detail of transport plan
L_{WP}	level of detail of work plan
M_{Ei}	number of planning cycles due to errors
M_i	number of planning cycles
M_{Ri}	number of planning cycles after release of planning result
N_{sp}	number of sub-processes
P_{all}	total number of all process elements
P_{Ei}	number of iterated process elements due to errors
P_i	number of iterated process elements

t_{end} end time of planning process (planning task completed)

t_i expected time for pending planning tasks

t_{ini} time representing receipt of the planning request

T_{plan} number of scheduled transport plans

t_{search} search time

t_{sp} duration of a sub-process

$t_{sp,all}$ total duration of process

$\bar{t}_{sp}$ mean duration of sub-processes

t_{start} start time of planning process

T_{used} number of transport plans used in manufacturing operations

t_{value} value-added time

t_{work} work time (not including contingency allowances, contingencies, etc.)

t_x specific time type

W_{plan} number of work plans created

W_{used} number of work plans used in manufacturing operations

SOP start of production

4 Key performance indicators in production planning processes

4.1 Production planning KPI system

The production planning KPIs have been organized in a multi-level KPI system which provides different key indicator levels for processes. Those levels range from evaluation of the planning processes in process-oriented key indicators, e.g. through the analysis of time data, process types, and information requirements, to evaluation of the specific planning task results. In this organizational structure, the more process-oriented key indicators on the one hand are valid across different disciplines. On the other hand the result-oriented key indicators tend to relate strongly to the predefined planning disciplines of the production planning processes. In this way, for example, key indicators such as floor space utilization or ratio of container types are used to evaluate the planning results of the planning disciplines of layout and logistics planning based on the application of the concepts developed in the planning process. Figure 2 provides an overview of the structure of the KPIs in production planning.

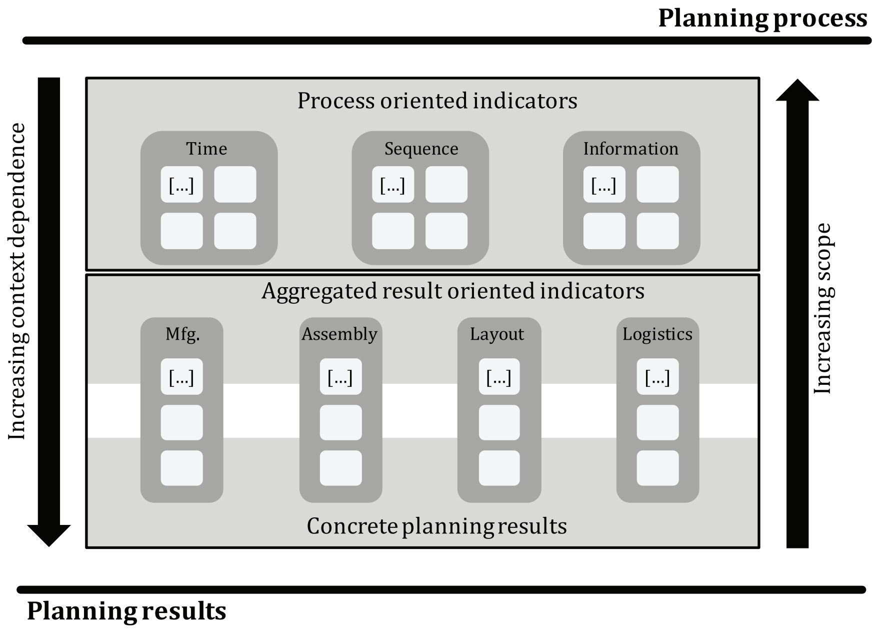

Figure 2 — Structure of the KPIs

The defined structure will be filled with sample key indicators on all levels. A consistent documentation of these indicators is ensured by use of a standardized key indicator template (see 4.2). Process-oriented key indicators can be identified by their broad scope of use, as they are neither discipline-specific nor specific to the individual stage of development. They are assigned to a specific context when adjusted to the user's planning processes requiring evaluation. Process-oriented key indicators such as these may represent for instance the iteration rate of a particular process. Another example for process-oriented key indicators might be ratios adjusted to a specific use case. In one scenario the information type rate mirrors the rate of digital information compared to a total amount. In another scenario the KPI compasses missing information instead. However, iterations taking place as part of the planning (e.g. revision work in production) a positive or negative trend cannot be assigned directly because, the reasons for a planning iteration (e.g. updated or new planning information, external or internal requirements) may vary in practice. Interpretation of the planning iteration depends on the context, such as observed planning phase and planning scope, and requires a thorough check. As the definition already resolves, key indicators based on concrete planning results are far more dependent upon the context and have a narrow, predefined scope of validity. Based on the core planning disciplines identified in the reference planning process, sample result KPIs can be derived for use in these domains.

NOTE Based on the planning disciplines and stage of development of the planning process in accordance with ISO 18828-2.

4.2 Formal definition of key performance indicators

The planning disciplines within this reference process are manufacturing, assembly, logistics and layout planning. These disciplines act, in this respect, as a base for the comparison of various production planning processes and a cross-discipline comparison. This document enhances options for performance management within a company and, if required, across multiple companies. Simultaneously, a distinction between key indicators in relation to the reference object needs to be drawn. In the first place, key process indicators are described presenting the planning processes that are clearly present and reveal possible ways to analyse the efficiency of the processes. Secondly, the planning quality, e.g. process output quality, is assessed using different key indicators in certain cases. The basic structure used to define key indicators is divided into three different parts. Table 1 presents an abridged version.

NOTE This is based on the structure of key indicators from ISO 22400-2.

