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**Automation systems and  
integration — Evaluating energy  
efficiency and other factors of  
manufacturing systems that influence  
the environment —**

**Part 2:  
Environmental performance  
evaluation process**

*ISO 20140-2:2018*  
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*Systemes d'automatisation et integration — Évaluation de l'efficacité  
énergétique et autres facteurs de fabrication des systèmes qui  
influencent l'environnement —*

*Partie 2: Processus d'évaluation de la performance environnementale*



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## 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](http://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](http://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 of 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 5, *Interoperability, integration and architectures of enterprise systems and automation applications*.

A list of all parts in the ISO 20140 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

ISO 20140 specifies a method for evaluating the energy efficiency and other factors of a manufacturing system that influence the environment, e.g. energy consumption, waste and release.

ISO 20140 is applicable to manufacturing systems for discrete, batch, and continuous manufacturing.

ISO 20140 focuses on manufacturing systems that have a hierarchical structure.

ISO 20140 can be used for:

- benchmarking of environmental performance against a generic reference manufacturing system or comparing between different manufacturing systems;
- alternative studies for improving environmental performance;
- setting targets of environmental performance improvement;
- visualizing the environmental performance of a manufacturing system under operation.

Expected users of ISO 20140 are:

- a) managers who are responsible for environmental conditions of a manufacturing system;
- b) engineers who design manufacturing processes for products;
- c) engineers who design a manufacturing system;
- d) engineers and foremen who are responsible for manufacturing products.

This document specifies a process for environmental performance evaluation of activities executed by a manufacturing system based on the general principles described in ISO 20140-1. The process uses environmental performance evaluation data based on ISO 20140-5.

This document does not specify any evaluation process specific to particular implementations of manufacturing systems.

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# Automation systems and integration — Evaluating energy efficiency and other factors of manufacturing systems that influence the environment —

## Part 2: Environmental performance evaluation process

### 1 Scope

This document specifies a process for environmental performance evaluation of activities executed by a manufacturing system based on the general principles described in ISO 20140-1. The process uses environmental performance evaluation data based on ISO 20140-5.

This document does not specify any evaluation process specific to particular implementations of manufacturing systems.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 20140-1, *Automation systems and integration — Evaluating energy efficiency and other factors of manufacturing systems that influence the environment — Part 1: Overview and general principles*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20140-1 and the following 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 <https://www.electropedia.org/>

#### 3.1

##### aggregated EPE data

numerical representation of *environmental influence* (3.3) caused by a manufacturing process in a given type of environmental influence and in a given mode

#### 3.2

##### energy efficiency

ratio or other quantitative relationship between an output of performance, service, goods or energy, and an input of energy

[SOURCE: ISO 50001:2011, 3.8, modified — Example and Note to entry have been deleted.]

**3.3  
environmental influence**

result of manufacturing process that can cause environmental impacts and that is considered throughout the life cycle of the manufacturing system associated with the process

Note 1 to entry: Environmental influence, such as energy consumed and CO<sub>2</sub> emitted, can cause environmental impacts, such as global warming and sea level rise.

EXAMPLE Amount of electric energy consumed; amount of CO<sub>2</sub> emitted; amount of hazardous substance discharged.

**3.4  
environmental KPI**

*key performance indicator* (3.7) that represents *environmental performance* (3.5)

**3.5  
environmental performance**

measurable results related to environmental aspects

[SOURCE: ISO 14045:2012, 3.5]

**3.6  
environmental performance evaluation data  
EPE data**

data that is used to evaluate the *environmental performance* (3.5)

[SOURCE: ISO 20140-5:2017, 3.6, modified.]

**3.7  
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]

**3.8  
system value**

worth or desirability ascribed to a manufacturing process

## 4 Framework of environmental performance evaluation process

The environmental performance evaluation process shall comprise the sub-processes of developing a specification of environmental performance evaluation, specifying the environmental KPIs, calculating the environmental KPIs, and reporting the evaluation results as illustrated in [Figure 1](#). This document specifies the requirements for these sub-processes.

a) Developing specification of environmental performance evaluation

A specification of environmental performance evaluation is developed in this process. This specification includes requirements for aggregated EPE data.

b) Specifying environmental KPIs

Environmental KPIs are specified by a formula with the necessary conditions, according to the specification of environmental performance evaluation specified by the process described in a) above.



c) Calculating the environmental KPIs

Values of each environmental KPI are calculated according to the environmental KPI specification specified by the process described in b) above.

An aggregated EPE data, which represents the environmental influence, is provided by the aggregation process for each KPI.

A system value is obtained for each KPI according to the specification of environmental performance evaluation specified by the process described in a) above.

NOTE The actual capture and calculation of system value for use in calculating each KPI is outside the scope of ISO 20140.

d) Reporting

The results of the environmental performance evaluation, such as environmental KPI specification and its calculated values, are reported with respect to the objectives of the environmental performance evaluation.

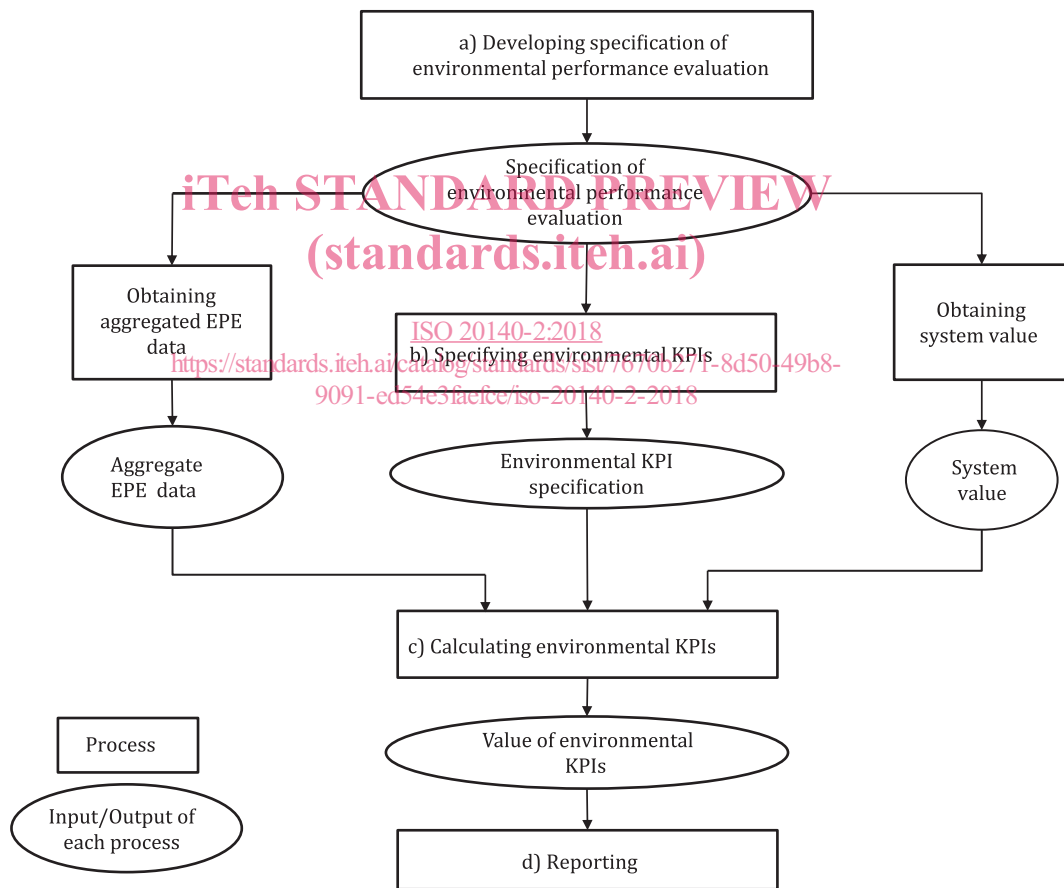


Figure 1 — Environmental performance evaluation process

## 5 Sub-processes of the environmental performance evaluation

### 5.1 Developing a specification of environmental performance evaluation

#### 5.1.1 General

A specification of environmental performance evaluation may be dedicated to a particular manufacturing system for determining the effectiveness of improvement of environmental performance. It may also be specified for multiple individual manufacturing systems in order to compare them as described in [Annex A](#).

Specifications of environmental performance evaluation shall specify the following items:

- a) objective of the evaluation;
- b) scope of the evaluation;
- c) requirements for aggregated EPE data.

#### 5.1.2 Objective of environmental performance evaluation

The objective of environmental performance evaluation shall clearly describe the reason why the evaluation is performed and which types of environmental influence are taken into account.

EXAMPLE 1 An objective is visualization and improvement of energy efficiency of a given manufacturing system under a particular production plan during a given period of time.

EXAMPLE 2 A company has two production facilities with different processes and performance criteria for the same type of car product. The company is planning to construct a new facility, and wants to select one of the existing facilities as a base design.

EXAMPLE 3 An objective is to evaluate the effect of replacing equipment for a particular step of a manufacturing process by comparing the new performance with the performance before the modification.

EXAMPLE 4 An objective is to calculate the advantageous effects of an improvement measure, such as reducing power during idle states, reducing idle time and coordinated scheduling of production.

#### 5.1.3 Scope of environmental performance evaluation

##### 5.1.3.1 General

The scope of environmental performance evaluation shall be appropriately determined so that environmental KPIs can be specified to satisfy the objectives.

##### 5.1.3.2 Target manufacturing process to be evaluated

The scope shall include the description of the target manufacturing process to be evaluated.

NOTE A target manufacturing process can be defined by a combination of a physical boundary and a time boundary or by a set of values characterizing the manufacturing process.

EXAMPLE If a manufacturing process is a batch process, an evaluation period is synchronized with a batch cycle of a process.

### 5.1.3.3 Level of detail of environmental performance evaluation

The scope should also include the decision regarding the level of detail of data for environmental performance evaluation according to the objective.

NOTE The level of detail could differ depending on the objective of the evaluation. This could, for example, include frequency of measurements (e.g. update every day, year, or month), cut-off intervals for data values and resolution of measurement.

### 5.1.4 Requirements for aggregated EPE data

The requirements for aggregated EPE data shall be specified according to the specification of environmental performance evaluation.

NOTE The requirements are used in the aggregation process. ISO 20140-3 specifies an aggregation process that provides aggregated EPE data in accordance with a given environmental performance evaluation specification by this document.

## 5.2 Specifying environmental KPIs

### 5.2.1 General

One or more environmental KPIs of the target manufacturing process shall be specified by environmental KPI specifications.

Environmental KPI specifications should include:

- a) objectives;
- b) types of the environmental influence considered;
- c) formulae to evaluate the environmental KPI;
- d) constraints.

Environmental performance of manufacturing systems may be expressed by multiple KPIs. See [Figure A.2](#).

### 5.2.2 Environmental KPIs

#### 5.2.2.1 General

Since different manufacturing processes can produce different types of products, values of environmental influence of different manufacturing processes cannot be compared directly. In order to normalize the values of environmental influence, the concept of system value is used to determine environmental KPIs.

NOTE Some KPIs defined by ISO 22400-2, such as comprehensive energy consumption, production loss ratio and storage and transportation loss ratio, can be an environmental KPI and can be used in formulae of environmental KPI specifications.

A general formula of an environmental KPI is expressed as a function  $F$  of system value and environmental influence, which can be represented by aggregated EPE data. See [Formula \(1\)](#).