IEEE P1734™/D0.8
Draft Standard for Quality of Electronic and Software Intellectual Property used in System and System on Chip (SoC) Designs

Sponsor

Design Automation Standards Committee
of the
IEEE Computer Society

Approved <XX Month 20XX>

IEEE-SA Standards Board

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Abstract: This specification defines a standard XML format for representing electronic IP quality information, based on an information model for electronic IP quality measurement. It includes a schema and the terms that are relevant for measuring electronic IP quality, including software that executes on the system. The schema and information model can be focused to represent particular categories of interest to IP users. In the context of this document, the term “IP” shall be used to mean Intellectual Property electronic design data. Electronic Design Intellectual Property is a term used in the electronic design community. It refers to a reusable collection of design specifications that represent the behavior, properties, and/or representation of the design in various media.

Keywords: Electronic Design Automation, EDA, XML Design Meta Data, Quality IP Metrics, QIP, XML Schema, Semantic Consistency Rules, SRCs, Design Environment, Use Models, Implementation Constraints, Register Transfer Logic, RTL, Verification IP, VIP, Analog and Mixes Signal, AMS, Micro-Electro-Mechanical Systems, MEMS, Electronic System Level, and ESL.

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Introduction

This introduction is not part of IEEE P1734/D0.8, Draft Standard for Quality of Electronic and Software Intellectual Property used in System and System on Chip (SoC) Designs.

The purpose of this standard is to provide a unified view of quality measures for IP to facilitate the use and integration of this IP used in electronic system design. These quality measures can be evaluated in the context of the end application to help determine suitability and plan mitigation measures for potential integration gaps. This can enable the continuous improvement of IP used for system design and verification by providing a mechanism for qualitative comparison between such IP. The standard IP quality measures and characteristic exchange format defined can be incorporated into a variety of EDA tools. The goal of this specification is to specify a quality standard metric that will account for the variances in designing, verifying and testing the IP, which will result in fair quality assessment, reducing the risk of schedule slip or mask spins due to faulty IP.

The working group consisted of electronic system, IP provider, semiconductor, and EDA companies, and used the VSI Alliance Quality IP (QIP) metric as a baseline for the metrics. The data specified by the standard is extensible in locations specified in the schema. This structure can be used as the basis of both manual and automatic methodologies.

This standardization project provides electronic design and system on chip engineers with a well-defined standard that meets their requirements in evaluating and validating IP and enables a step function increase in their productivity. This standardization project also provides the EDA industry with a standard to which they can adhere and that they can support in order to deliver their solutions in this area.

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Participants

At the time this draft standard was submitted to the IEEE-SA Standards Board for approval, the Quality IP Metrics Working Group had the following membership:

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Peter Arnoldy	Jordy Li	Ka Lun Ng
Stephane Bonniol	Kenneth Lo	Michael Posner
Ahmed Dabbagh	Mark Mok	Omri Raisman
Thad Gardner	Gerardo Nahum	Andreas Voerg

The following members of the <individual/entity> balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

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Draft Standard for Quality of Electronic and Software Intellectual Property used in System and System on Chip (SoC) Designs

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1. Overview

1.1 Scope

This specification defines a standard XML format for representing electronic IP quality information, based on an information model for electronic IP quality measurement. It includes a schema and the terms that are relevant for measuring electronic IP quality, including software that executes on the system. The schema and information model can be focused to represent particular categories of interest to IP users. In the context of this document, the term "IP" shall be used to mean Intellectual Property electronic design data. Electronic Design Intellectual Property is a term used in the electronic design community. It refers to a reusable collection of design specifications that represent the behavior, properties, and/or representation of the design in various media.

1.2 Purpose

The purpose of this standard is to provide a unified view of quality measures for IP to facilitate the use and integration of this IP used in electronic system design. This will enable the continuous improvement of IP used for system design and verification by providing a mechanism for qualitative comparison

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between such IP. The standard IP quality measures and characteristic exchange format defined can be incorporated into a variety of EDA tools.

1.3 Design environment (DE)

The IP Quality specification is a mechanism to express and exchange information about design IP, its development, data management, documentation, verification and validation processes, as well as evaluating the quality and stability of the owning or development organization. While the XML description formats are the core of this standard, describing the quality specification in the context of its basic use-model, the design environment (DE), more readily depicts the extent and limitations of the semantic intent of the data. The DE coordinates a set of tools and IP, or expressions of that IP (e.g., models), through the evaluation and manipulation of meta-data descriptions of the IP such that the IP can be efficiently integrated into and SoC and reused.

1.3.1 Design intellectual property

QIP is structured around the concept of IP re-use. Electronic Design Intellectual Property, or IP, is a term used in the electronic design community to refer to a reusable collection of design specifications that represent the behavior, properties, and/or representation of the design in various media. The name IP is partially derived from the common practice of considering a collection of this type to be the intellectual property of one party. Both hardware and software collections are encompassed by this term.

Examples of these collections may include the following:

a) Design objects—This can include the following:
   1) Fixed HDL descriptions: Verilog®[1], VHDL
   2) Verification IP descriptions: Verilog [B1][2], VHDL[B2]
   3) Hardened IP descriptions: GDSII, LEF, LIB, LVS, Characterization Reports
   4) Software descriptions: C, C++, etc
   5) HDL-specified verification IP (e.g., basic stimulus generators and checkers)

b) IP views—This is a list of different views (levels of description and/or languages) to describe the IP object. These views include:
   1) Design view: RTL Verilog or VHDL, flat or hierarchical components
   2) Simulation view: model views, targets, simulation directives, etc.
   3) Documentation view: Standard, User Guide, etc.
   4) Supporting scripts: synthesis, makefile, manufacturing test, etc

1.4 QIP Compliant enabled implementations

Complying with the rules outlined in this section allows the provider of tools or IP to class their products as QIP Compliant. Conversely, any violation of these rules removes that naming right. This section first

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[2] The number in brackets correspond to that of the bibliography in Annex A

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introduces the set of metrics for measuring the valid use of the specifications. It then specifies when those validity checks are performed by the various classes of products and providers: DEs, point tools, and IPs.

a) Parse validity

   1) Parsing correctness: Ability to read all QIP descriptions.

   2) Parsing completeness: Cannot require information that could be expressed in a QIP format to be specified in a non-QIP format. Processing of all information present in a QIP document is not required.

b) Description validity

   1) Schema correctness: Metrics are described using XML files that conform to the QIP schema.

   2) Usage completeness: Extensions to the QIP schema shall only be used to express information that is not currently described in QIP. This information shall be forwarded to the P1734 committee for potential inclusion in a later release.

c) Semantic validity

   1) Semantic correctness: Adheres to the semantic interpretations of QIP data described in this standard.

   2) Semantic completeness: Obeys all the semantic consistency rules described in Annex B.

These validity rules can be combined with the product class specific rules to cover the full QIP enabled space. The following subsections describe the rules a provider has to check to claim a tool or DE is QIP Compliant.

A QIP Compliant design environment or point tool may read descriptions based on multiple versions of the QIP schema. If the DE or point tool does provide this capability, the effect shall be as if all of the descriptions had been translated by an XSL Transform (XSLT), which converts descriptions from one version to the next.

1.4.1 Design environments

A QIP Enabled design environment:

a) Shall follow the parse validity requirements shown in 1.4.

b) When modifying any existing QIP descriptions, shall do so without losing any pre-existing information. In particular, it shall preserve any vendor extension data included in the existing QIP description

1.5 Conventions used

The conventions used throughout the document are included here.

QIP schema is case-sensitive.

1.5.1 Visual cues (meta-syntax)

Bold: shows required keywords and/or special characters, e.g., addressSpace. For the initial definitional use (per element), keywords are shown in **boldface-red** text, e.g, **bitsInLau** (see also: 1.6).

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Bold italics: shows group names or data types, e.g., ***nameGroup*** or ***boolean***. For definitions of types see Annex D.

Courier: shows examples, external command names, directories and files, etc.,

e.g., address `0x0` is on `D[31:0]`

1.5.2 Notational conventions

The keywords “required”, “shall”, “shall not”, “should”, “should not”, “recommended”, “may”, and “optional” in this document are to be interpreted as described in the IETF Best Practices Document 14, RFC-2119.

1.5.3 Syntax examples

Any syntax examples shown in this Standard are for information only and are only intended to illustrate the use of such syntax.

1.5.4 Graphics used to document the schema

http://www.w3.org/TR/2004/REC-xmlschema-1-20041028 specifies the XML schema language used to define the QIP XML schemas. Normative details for compliance to the QIP standard are contained in the schema files. Within this document, pictorial representations of the information in the schema files illustrate the structure of the schema and define any constraints of the standard. With the exception of scope and visibility issues, the information in the figures and the schema files is intended to be identical. Where the figures and schema are in conflict, the XML schema file shall take precedence.

1.5.4.1 Elements and attributes

The element is the fundamental building block on which this standard is based. An element may be either a leaf element, which is a container for information, or a branch element, which may contain further branch elements or leaf elements.

A leaf or branch element may also contain attributes. Attributes are containers for information within the containing element.

1.5.4.2 Types

A type is a designation of the format for the contents of an element or attribute. There are two different styles of types that can be defined. A type may be assigned to a leaf element or an attribute. This type is called a simpleType and defines the format of data that may be stored in this container. A type may also be assigned to a branch element. This type is called a complexType and defines further elements and attributes contained in the branch element.

1.5.4.3 Diagrams

The diagrams used throughout this standard graphically detail the organization the elements and attributes.

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1.5.4.3.1 Elements and sequences

Figure 1 shows the sequence-compositor. At the left is a branch element, element1. **element1** is connected to a sequence-compositor. The sequence-compositor defines the order the subelements appear in the branch element. **subElement1** shall appear first inside of **element1**. This is followed by **subElement2**, and **subElement3** before closing **element1**.

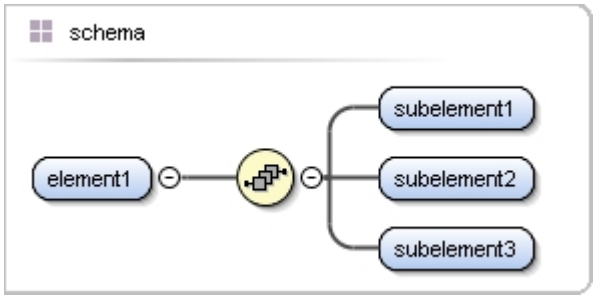

Figure 1—Sequence Compositor

1.5.4.3.2 Elements and choices

Figure 2 shows the variations of the choice-compositor. root is connected to a choice-compositor. The choice-compositor specifies that one of the elements on the right side shall be chosen. root may contain one of the following: element1, element2, or element3. Each subelement is also connected to a choice-compositor.

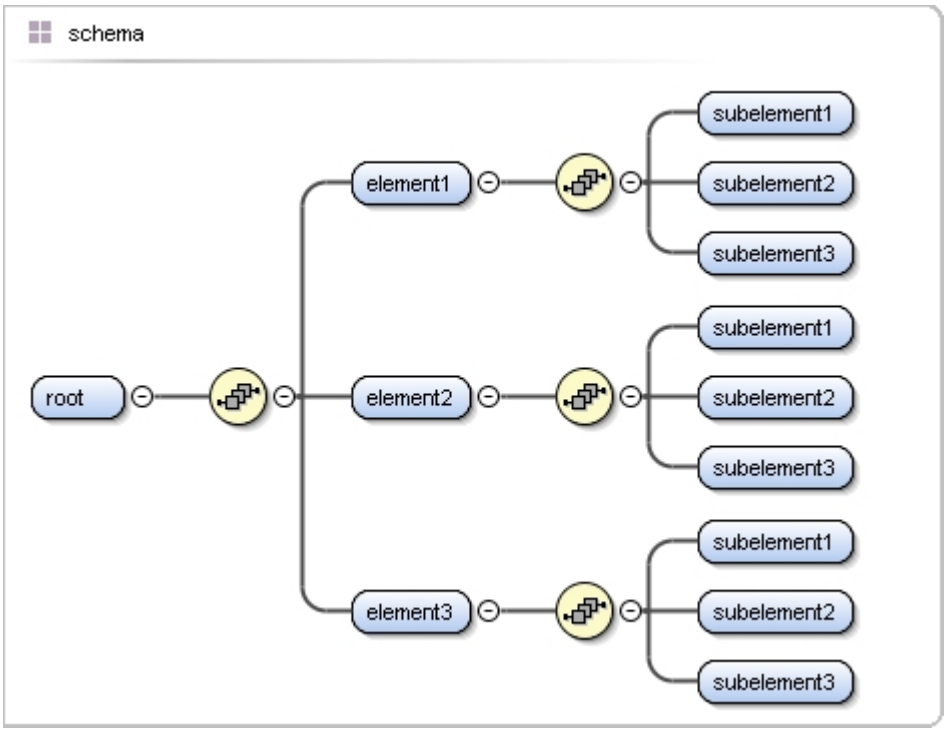

Figure 2—Choice Compositor Variations

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1.6 Use of color in this standard

This standard uses a minimal amount of color to enhance readability. The coloring is not essential and does not affect the accuracy of this standard when viewed in pure black and white. The places where color is used are the following:

— Cross references that are hyperlinked to other portions of this standard are shown in underlined-blue text (hyperlinking works when this standard is viewed interactively as a PDF file).

— Syntactic keywords and tokens in the formal language definitions are shown in **boldface-red** text.

1.7 Contents of this standard

The organization of the remainder of this standard is as follows:

— Clause 2 provides references to other applicable standards that are assumed or required for this standard.

— Clause 3 defines terms, acronyms, and abbreviations used throughout the different specifications contained in this standard.

— Clause 4 defines the use model.

— Clause 5 describes the schema structure.

— Clause 6 describes the compatability with and differences from the VSIA QIP.

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2. Normative references

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The XML schema namespace specification is available from the W3C®[3] web site:
http://www.w3.org/2001/XMLSchema
http://www.w3.org/2001/XMLSchema-instance

The XML Schema specification is available from the W3C web site:
http://www.w3.org/TR/2004/REC-xmlschema-1-20041028

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3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. *The IEEE Standards Dictionary: Glossary of Terms & Definitions* should be referenced for terms not defined in this clause.[4]

design database: Working storage for both meta-data and component information that helps create and verify systems and subsystems.

design environment (DE): The coordination of a set of tools and IP, or expressions of that IP (e.g., models) so the system-design and implementation flows of a SoC re-use-centric development flow is efficiently enabled. This is managed by creating and maintaining a meta-data description of the SoC.

electronic design intellectual property (IP): A term used in the electronic design community to refer to a reusable collection of design specifications that represent the behavior, properties, and/or representation of the design in various media. The name IP is partially derived from the common practice of considering a collection of this type to be the intellectual property of one party. Both hardware and software collections are encompassed by this term. IP utilized in the context of a SoC design or design flow may include specifications; design models; design implementation descriptions; verification coordinators, stimulus generators, checkers and assertion / constraint descriptions; soft design objects (such as embedded software and real-time operating systems); design and verification flow information and scripts.

IP provider: Creator and supplier of IP.

IP repository: Database of IP.

meta-data: A tool-interpretable way of describing the design-history, locality, object association, configuration options, constraints against, and integration requirements of an object.

meta IP: Meta-data description of an object.

schema: A means for defining the structure, content, and semantics of Extensible Markup Language (XML) documents

semantic consistency rules (SCRs): Additional rules applied to an XML description that cannot be expressed in the schema. Typically, these are rules between elements in multiple XML descriptions.

use model: A process method of working with a tool.

user interface: Methods of interacting between a tool and its user.

validation: Proving the correctness of construction of a set of components.

verification: Proving the behavior of a set of connected components.

view: An implementation of a component. A component may have multiple views, each with its own function in the design flow.

verification IP (VIP): Components included in a design for verification purposes.

[4] *The IEEE Standards Dictionary: Glossary of Terms & Definitions* is available at http://shop.ieee.org/.

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Extensible Markup Language (XML): A simple, very flexible text format derived from SGML (see ISO/IEC 8879 [B3]).

XSLT: XSL Transform is a particular program written in the XSL language for performing a transformation (from one version to the next).

3.2 Acronyms and abbreviations

DE	design environment
EDA	electronic design automation
HDL	hardware description language
IP	electronic design intellectual property
QIP	Quality IP
RTL	register transfer level (design)
SCR	semantic consistency rule
SoC	system on chip
VIP	verification IP
XML	Extensible Markup Language
XSLT	XSL Transform

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4. Interoperability use model

To introduce the use-model for the QIP metric, it is first necessary to identify specific roles and responsibilities within the model, and then relate these to how the QIP metric impact their interactions. All or some of the roles can be mixed within a single organization, e.g., some EDA providers are also providing IP, a component IP provider can also be a platform provider, and an IP system design provider may also be a consumer.

4.1 Roles and responsibilities

For this Standard, the roles and responsibilities are restricted to the scope of QIP v0.5.

4.1.1 Component IP provider

This is a person, group or company creating IP components or subsystems for integration into a SoC design. These IPs can be hardware components (processors, memories, buses, etc.), verification components, and/or hardware-dependent software elements. They may be provided as source files or in a compiled or hardened form (i.e., simulation model or GDSII). For example, an IP may be provided with a functional description, a timing description, documentation, some implementation or verification constraints and/or scripts, and some parameters to characterize (or configure) the IP. All these types of characterization data may be evaluated as meta-data compliant with the QIP Metric.

The IP provider can use one or more EDA tools to create/refine/debug IP. At some point, this IP can be transferred to customers, partners and external EDA tool suppliers along with the completed QIP metric XML data.

4.1.2 IP design integrator

This is a person, group or company that integrates and validates IP provided by one or more IP providers to build system platforms, which are complete and validated systems or sub-systems. Like the IP provider, the IP integrator can use EDA tools to create/refine/debug its platform and to validate and evaluate the QIP data.

The QIP data is used to quantitatively evaluate criteria specific to the IP vendor and the supplied IP to assist in determining the suitability of that IP for an end application. The criteria contained in the QIP illustrate the stability and capabilities of the vendor, the rigor and care taken in the development of the IP, and identifies areas for more detailed discussions with the vendor to potentially mitigate issues identified. While the QIP provides a score, this is merely an indicator of how the criteria were answered and not an absolute quality value for the IP. Each end application may have different goals that can change the importance of the criteria.

4.1.3 QIP tool supplier

This is a group or company that provides tools to create or verify a QIP assessment for an IP or platform IP. There are **two** major tools, which could be combined, required in the flow:

— schema validator

— metric calculator

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4.2 IP exchange flows

This section describes a typical IP exchange flow that the QIP metric supports between the roles defined in 4.1. The component IP provider generates a completed QIP XML file that represents the quality criteria of the IP in question, which is then evaluated by the IP integrator. Both the IP provider and integrator may use a QIP assessment tool to parse the schemas and supplied information. By way of example, the specific exchange flow shown in Figure 3 can benefit from use of the QIP specification.

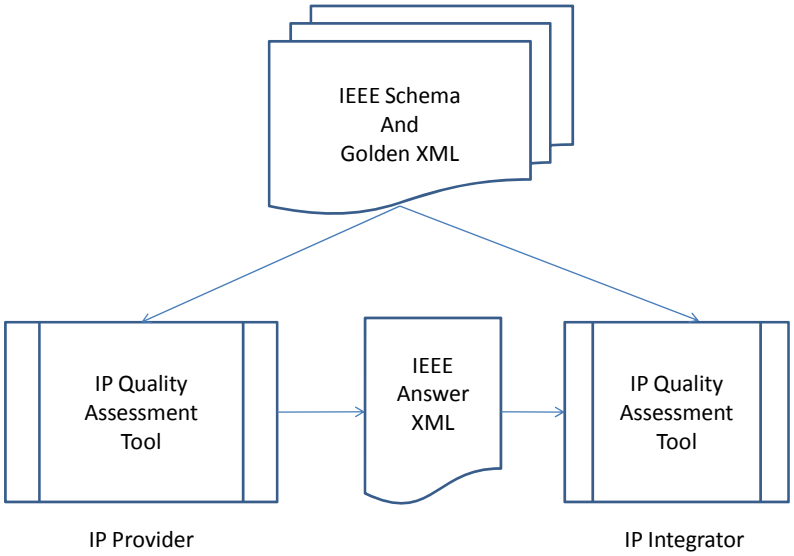

Figure 3—QIP Use Flow

The IP provider's tool initializes and or updates the list of IP quality checks in its internal database by reading the golden XML file with its IEEE schema for validation.

The tool provides features for the assessment of the IP quality checks and for metric calculation based on IP-specific input from the IP provider.

The tool exports assessment results to an Answer XML file, compliant with the IEEE schema, to communicate the quality criteria associated with the IP in question.

The IP integrator's tool imports assessment results from an Answer XML file with its IEEE schema for validation, and initializes or updates the assessments of the IP quality checks in its internal database.

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5. QIP schema structures

5.1 QIP schema structure for golden XML

This first schema of the QIP specification is used to describe the golden IP quality checks provided by the standard. The element qipReference is the top level element of this schema. See Figure 4 below

Figure 4—qipReference element

5.1.1 Golden XML schema description

The top level element **qipReference** has an attribute **version** that specifies the version number of the golden XML file. This version number is used to keep a common reference between the different XML files: golden, answer XML files.

The top level element **qipReference** contains 1 or multiple elements **assessment**.

The element **assessment** represents the set of quality checks used for a given type of quality assessment: Vendor, Soft IP Integration, Soft IP Development, Hard IP Integration, Hard IP Development, Verification IP, and Software IP. It has 3 attributes:

- The attribute **id** is unique and is used to strictly identify the assessment
- The attribute **order** is used to specify the sequence order of different assessments. The tool uses this attribute to display in a GUI the list of assessments in a coherent order
- The attribute **qipId** is the reference id of the IEEE QIP database

The element **assessment** contains 1 or multiple elements **topic**.

The element **topic** represents the set of quality metrics used for a given type of area of concerns. It has 4 attributes:

- The attribute **id** is unique and is used to strictly identify the topic
- The attribute **order** is used to specify the sequence order of different topics. The tool uses this attribute to display in a GUI the list of topics in a coherent order
- The attribute **title** is used to specify the title of the topic. The tool uses this attribute to display the title of the topic in a GUI.

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The element **topic** contains 0 or multiple elements topic and 0 or multiple elements **criterium** as shown in Figure 5 below.

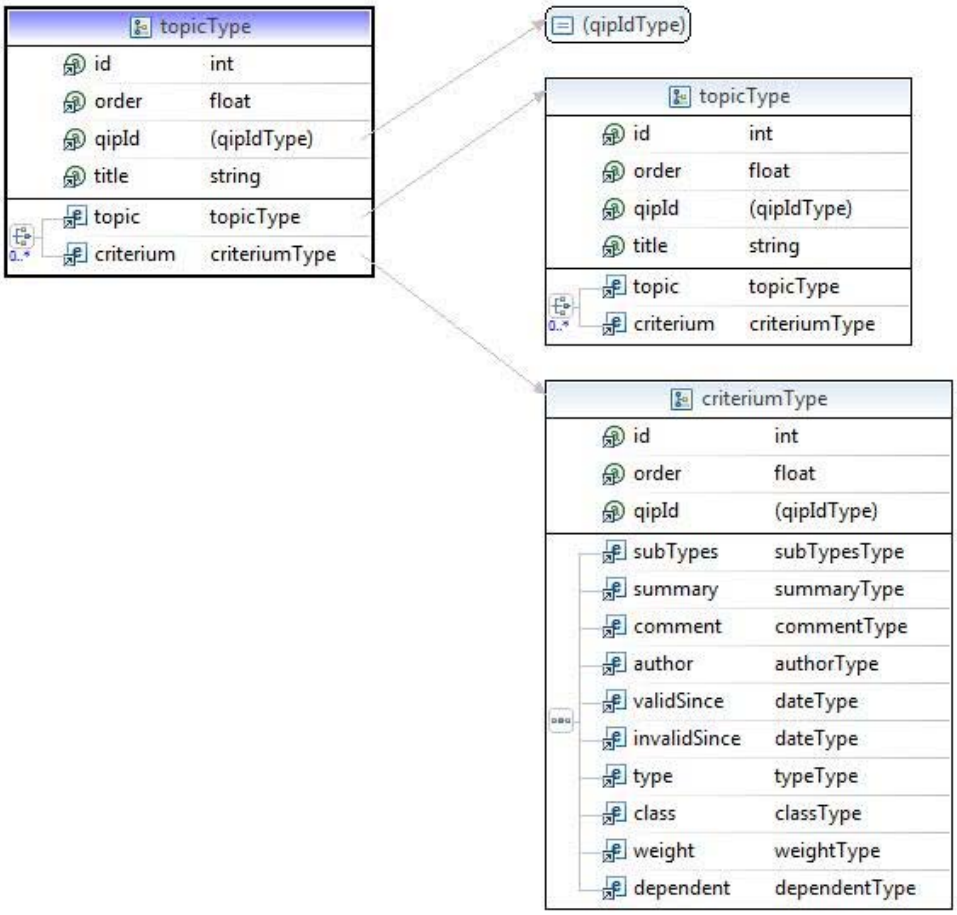

Figure 5—topic element

The element **criterium** represents a Quality Check item. It has 3 attributes:

- The attribute **id** is unique and is used to strictly identify the criterium
- The attribute **order** is used to specify the sequence order of different criteria. The tool uses this attribute to display in a GUI the list of criteria in a coherent order
- The attribute **qipId** is the reference id in the IEEE QIP database

The element **criterium**, shown in Figure 6 contains the following elements:

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- The element **subTypes** specifies the list of IP subtypes this criterium is relevant for. If left empty, it means that the criterium is valid for any subtype. The expected values for the subtype are: Digital, Analog/AMS, I/O and ESD, Memory, MEMS, DupEnabled. The tool uses this attribute to select the appropriate list of criterium for assessment.

- The element **summary** contains the text in natural language, subject of the criterium. The tool uses this attribute to display the subject text of the criterium in a GUI

- The element **comment** contains an additional text in natural language for extra comment. The tool uses this attribute to display comment text of the criterium in a GUI

- The element **author** contains the name of the Quality Check item creator. The tool uses this attribute to display the author of the criterium in a GUI

- The element **validSince** specifies the start date validity of the criterium. The tool uses this attribute to check the validity of the criterium

- The element **invalidSince** specifies the end date validity of the criterium. The tool uses this attribute to check the validity of the criterium

- The element **type** specifies the type of expected answers to the criterium; there are three kinds of answers: a/o/n (a/o/n, Always, Often, Never), y/n (y/n, y, n), or empty for free text. The tool uses this attribute to propose the possible answer values for the assessment of the criterium

- The element **class** specifies the class of the criterium; there are four classes: Imperative, Rule, Guideline, or Optional. The tool uses this attribute to classify the criterium

- The element **weight** specifies the integer score of the criterium when satisfied. The tool uses this attribute for scoring and consolidation

- The element **dependent** specifies the integer id of another criterium from which the current criterium depends. If the referenced criterium is not satisfied then the current criterium is not relevant. The tool uses this attribute to identify the parent of the criterium

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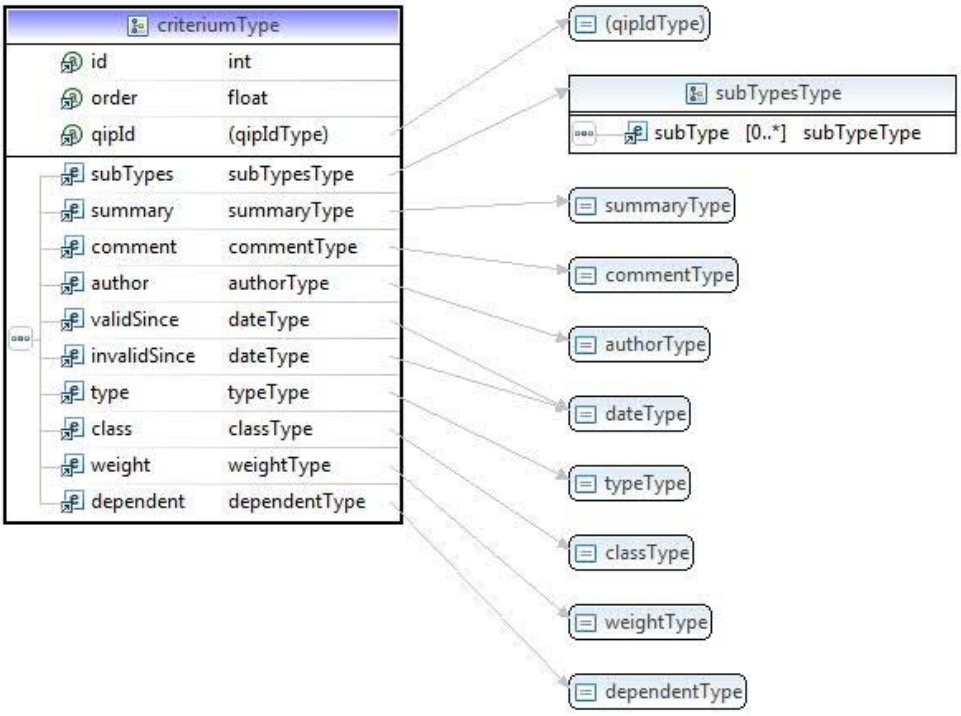

Figure 6—criterium element

5.1.1.1 Example

The example below shows the first lines of a golden XML listing the standard quality checks for a Hard IP Development purpose:

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```
<?xml version="1.0" encoding="ISO-8859-1" ?>
<!--  IEEE P1734 QIP Standard - Golden XML Reference by edacentrum  -->
- <ieee_p1734:qipReference ieee_p1734:version="0.1" xmlns:ieee_p1734="https://secure.edacentrum.de/standardisierung/qip"
   xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="https://secure.edacentrum.de/standardisierung/qip https://secure.edacentrum.de/standardisierung/qip/qip_golden.xsd">
   <!--  assessmentId=1  -->
  - <ieee_p1734:assessment ieee_p1734:id="1" ieee_p1734:order="1" ieee_p1734:title="Vendor">
    - <ieee_p1734:topic ieee_p1734:id="1" ieee_p1734:order="1" ieee_p1734:qipId="1" ieee_p1734:title="Vendor Assessment">
      - <ieee_p1734:topic ieee_p1734:id="2" ieee_p1734:order="2" ieee_p1734:qipId="1.1" ieee_p1734:title="Processes">
        - <ieee_p1734:criterium ieee_p1734:id="1" ieee_p1734:order="1" ieee_p1734:qipId="1.01.01">
            <ieee_p1734:subTypes />
            <ieee_p1734:summary>Is the vendor or the IP department certified for a industry quality standard like e.g. ISO9001, CMMI, ISO/TS, 16949 or others?
              </ieee_p1734:summary>
            <ieee_p1734:comment />
            <ieee_p1734:author>IEEE P1734 QIP Working Group</ieee_p1734:author>
            <ieee_p1734:validSince>2008-04-19 00:00:00</ieee_p1734:validSince>
            <ieee_p1734:invalidSince />
            <ieee_p1734:type>y/n</ieee_p1734:type>
            <ieee_p1734:class>Rule</ieee_p1734:class>
            <ieee_p1734:weight>5</ieee_p1734:weight>
            <ieee_p1734:dependent />
          </ieee_p1734:criterium>
        - <ieee_p1734:criterium ieee_p1734:id="2" ieee_p1734:order="2" ieee_p1734:qipId="1.01.02">
            <ieee_p1734:subTypes />
            <ieee_p1734:summary>Is the development process for IP defined and documented?</ieee_p1734:summary>
            <ieee_p1734:comment />
            <ieee_p1734:author>IEEE P1734 QIP Working Group</ieee_p1734:author>
            <ieee_p1734:validSince>2008-04-19 00:00:00</ieee_p1734:validSince>
            <ieee_p1734:invalidSince />
            <ieee_p1734:type>y/n</ieee_p1734:type>
            <ieee_p1734:class>Rule</ieee_p1734:class>
            <ieee_p1734:weight>5</ieee_p1734:weight>
            <ieee_p1734:dependent />
          </ieee_p1734:criterium>
        - <ieee_p1734:criterium ieee_p1734:id="3" ieee_p1734:order="3" ieee_p1734:qipId="1.01.03">
            <ieee_p1734:subTypes />
            <ieee_p1734:summary>Is the documented development process for IP followed consistently?</ieee_p1734:summary>
            <ieee_p1734:comment>At a minimum, all new IP needs to use this process.</ieee_p1734:comment>
            <ieee_p1734:author>IEEE P1734 QIP Working Group</ieee_p1734:author>
            <ieee_p1734:validSince>2008-04-19 00:00:00</ieee_p1734:validSince>
            <ieee_p1734:invalidSince />
            <ieee_p1734:type>y/n</ieee_p1734:type>
            <ieee_p1734:class>Rule</ieee_p1734:class>
            <ieee_p1734:weight>5</ieee_p1734:weight>
            <ieee_p1734:dependent />
          </ieee_p1734:criterium>
```

5.2 QIP schema structure for the answer XML

This second schema of the QIP specification is used to describe the answers to the IP quality metrics. The element qipAnswer, Figure 7, is the top level element of this schema.

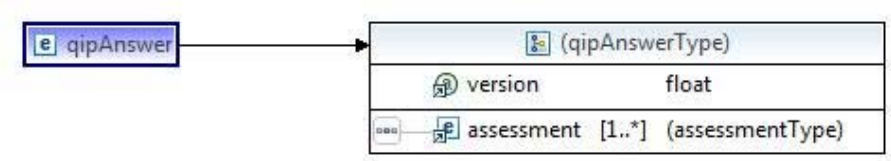

Figure 7—qipAnswer element

5.2.1 Description

The top level element **qipAnswer** has an attribute **version** that specifies the version number of the golden XML file. This version number is used to keep a common reference between the different XML files: golden, answer XML files.

The top level element **qipAnswer** contains 1 or multiple elements **assessment**.

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The element **assessment**, shown in Figure 8 below, represents the set of quality metrics used for a given type of quality assessment: Vendor, Soft IP Integration, Soft IP Development, Hard IP Integration, Hard IP Development, Verification IP, or Software IP. It has 1 attribute:

— The attribute **id** is unique and is used to strictly identify the assessment

The element **assessment** contains 1 or multiple elements **criterium**.

The element **criterium** represents a Quality Check item. It has 1 attribute:

— The attribute **id** is unique and is used to strictly identify the criterium.

The element **criterium** contains the following elements:

— The element **answer** contains answer to the criteria. The expected values for the answer are: a/o/n, Always, Often, Never, y/n, y, n, or empty for free text. The tool uses this attribute to write or read the answer of the criterium

— The element **comment** contains a text in natural language for comment. The tool uses this attribute to write or read the comment of the criterium

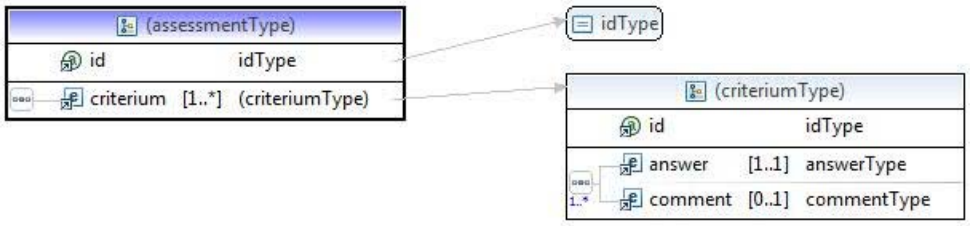

Figure 8—assessmentType element

5.2.1.1 Example

The example below shows the first lines of an answer XML for an example Hard IP Development quality checks:

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```
<?xml version="1.0" encoding="UTF-8" ?>
<!-- IEEE P1734 QIP Standard - XML questionnaire template -->
<ieee_p1734:qipAnswer
  xmlns:ieee_p1734="https://secure.edacentrum.de/standardisierung/qip"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="https://secure.edacentrum.de/standardisierung/qip
  https://secure.edacentrum.de/standardisierung/qip/qip_answer.xsd">
<ieee_p1734:assessment ieee_p1734:id="1">
<ieee_p1734:criterium ieee_p1734:id="1">
<ieee_p1734:answer>n</ieee_p1734:answer>
<ieee_p1734:comment />
</ieee_p1734:criterium>
<ieee_p1734:criterium ieee_p1734:id="2">
<ieee_p1734:answer>y</ieee_p1734:answer>
<ieee_p1734:comment />
</ieee_p1734:criterium>
<ieee_p1734:criterium ieee_p1734:id="3">
<ieee_p1734:answer>y</ieee_p1734:answer>
<ieee_p1734:comment />
</ieee_p1734:criterium>
<ieee_p1734:criterium ieee_p1734:id="4">
<ieee_p1734:answer>y</ieee_p1734:answer>
<ieee_p1734:comment />
</ieee_p1734:criterium>
<ieee_p1734:criterium ieee_p1734:id="5">
<ieee_p1734:answer>n</ieee_p1734:answer>
<ieee_p1734:comment />
</ieee_p1734:criterium>
<ieee_p1734:criterium ieee_p1734:id="6">
<ieee_p1734:answer>y</ieee_p1734:answer>
<ieee_p1734:comment />
</ieee_p1734:criterium>
<ieee_p1734:criterium ieee_p1734:id="7">
<ieee_p1734:answer>y</ieee_p1734:answer>
<ieee_p1734:comment />
</ieee_p1734:criterium>
```

5.3 Tooling requirements for operating on golden xml

The golden XML file contains the complete list of quality criteria (or questions) classified by topic and assessment type. The XML elements criterium, topic, and assessment contain attributes and sub elements, used to store the relevant data and information to enable automation of the QIP management with tools. The golden XML can be created from and downloaded via the internet at the URL: https://secure.edacentrum.de/qip/goldenxml

The tool shall read and parse the golden XML file, check the semantic of the imported XML file with the golden XML schema, and translate the XML structure in a proprietary data structure format. The golden XML schema file is accessible on the IEEE repository via internet at the URL: https://secure.edacentrum.de/standardisierung/qip/qip_golden.xsd

If an error is detected during the golden XML file import, the tool shall display an explicit message with the detailed information for debugging and stop the import operation without creating or updating its internal data structure. By way of example, an error shall be generated if a wrong value is supplied for a field subType. See Figure 9 for an example of a means for displaying this information.

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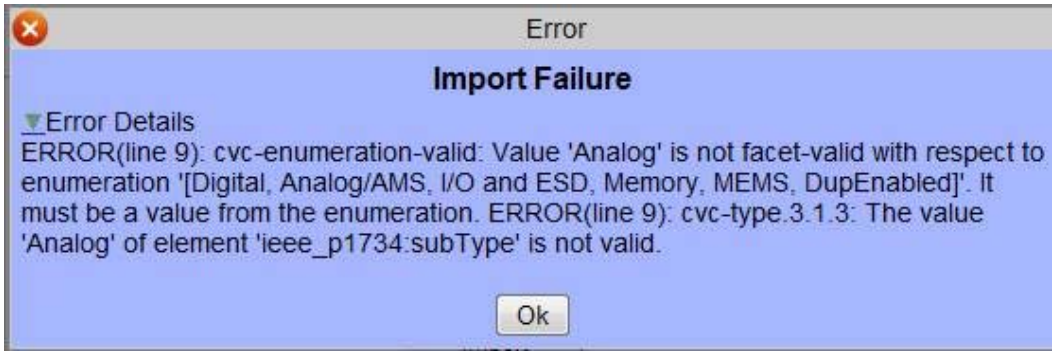

Figure 9— Golden XML import error

If no errors are detected during the golden XML file import, the tool shall create or update its internal data structure with the information provided in the golden XML file.

The tool shall interpret the different XML elements and attributes as described in the chapter 4.3.1.

The tool shall operate on the QIP criteria following the rules described in the annex B.

5.3.1 QIP Checklist table construction using the golden XML

The top level element of the golden XML file holds the version number of the golden XML file and the URL for XML schemas. The tool shall use the attributes xmlns:* to search for the golden XML schema. The tool should store the float attribute **version** in its internal data structure to later check the coherence with imported answer XML files version.

Example:

```
<ieee_p1734:qipReference ieee_p1734:version="0.1"
xmlns:ieee_p1734="https://secure.edacentrum.de/standardisierung/qip"
xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="https://secure.edacentrum.de/standardisierung/qip
https://secure.edacentrum.de/standardisierung/qip/qip_golden.xsd">
…
</ieee_p1734:qipReference>
```

5.3.2 Assessments

The second level elements of the golden XML file represent the highest level topical areas of the QIP: the types of assessment. These are: Vendor, Soft IP Integration, Soft IP Development, Hard IP Integration, Hard IP Development, Verification IP, Software IP.

Example:

```
<ieee_p1734:assessment ieee_p1734:id="1" ieee_p1734:order="1"
ieee_p1734:title="Vendor">
….
</ieee_p1734:assessment>
```


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The tool shall create a specific assessment table for each second level element of the golden XML. The text attribute **title** shall be used by the tool to display the title of the assessment table.

5.3.3 Top Level Topics

The third level elements of the Golden XML file represent the top level topical areas of the QIP assessment. These are: Vendor Assessment, IP Ease of Reuse, Design & Verification Quality

Example:

```
<ieee_p1734:topic ieee_p1734:id="101" ieee_p1734:order="1"
ieee_p1734:qipId="1" ieee_p1734:title="IP Ease of Reuse">
…
</ieee_p1734:topic>
```

The tool shall create a specific section for each third level element of the golden XML, within the assessment table. The attribute **qipId** shall be used by the tool to form and display a unique name for the section header row. The text attribute **title** shall be used by the tool to display the title of the top level topical area in the header row of the corresponding section. The float attribute **order** shall be used by the tool to display the different top level topical areas in the proper order.

5.3.4 Topics

The fourth level elements of the golden XML file represent the topical areas within the top level topical areas of the QIP assessment. These are for example: Configurability and Parameterization, Build Environment, Portability Issues, and others.

Example:

```
<ieee_p1734:topic ieee_p1734:id="103" ieee_p1734:order="3"
ieee_p1734:qipId="1.1.1" ieee_p1734:title="Configurability and
Parameterization">
…
</ieee_p1734:topic>
```

The tool shall create a specific section for each fourth level element of the golden XML, within the parent top level topical area sections of the assessment table. The attribute **qipId** shall be used by the tool to form and display a unique name for the section header row. The text attribute **title** shall be used by the tool to display the title of the topical area in the header row of the corresponding section. The float attribute **order** shall be used by the tool to display the different topical areas in the proper order.

5.3.5 Questions

The fifth level elements of the golden XML file represent either the final topical sub-areas or questions (criterium elements). The sixth level elements of the golden XML file, if any, represent questions (criterium elements). The criterium elements are the leaves of the tree structure.

Example:

```
<ieee_p1734:criterium ieee_p1734:id="468" ieee_p1734:order="1"
ieee_p1734:qipId="1.1.1.1">
<ieee_p1734:subTypes>
```


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```
<ieee_p1734:subType>Digital</ieee_p1734:subType>
<ieee_p1734:subType>Analog/AMS</ieee_p1734:subType>
<ieee_p1734:subType>Memory</ieee_p1734:subType>
</ieee_p1734:subTypes>
<ieee_p1734:summary>Can you change the parametrics through pin
programmability?</ieee_p1734:summary>
<ieee_p1734:comment/>
<ieee_p1734:author>IEEE P1734 QIP Working Group</ieee_p1734:author>
<ieee_p1734:validSince>2008-04-19 00:00:00</ieee_p1734:validSince>
<ieee_p1734:invalidSince/>
<ieee_p1734:type>y/n</ieee_p1734:type>
<ieee_p1734:class>Rule</ieee_p1734:class>
<ieee_p1734:weight>5</ieee_p1734:weight>
<ieee_p1734:dependent>467</ieee_p1734:dependent/>
</ieee_p1734:criterium>
```

The tool shall create a specific row for each fifth or sixth level criterium element of the golden XML file, within the parent topical area sections of the parent top level topical area sections of the assessment table. The attribute **qipId** shall be used by the tool to form and display a unique name for the question row. The float attribute **order** shall be used by the tool to display the different questions (criterium) in the proper order. The enumerated field **subTypes** shall be used by the tool to filter the question depending of the IP subtype selected by the user. The tool shall not display a question that does not reference the user's selected subtype in its subtypes list.

The tool should display the text of the field **summary** in the question row. The tool should propose an entry for user's **comment** in the question row. The tool shall propose a choice list for the answer entry with enumerated values depending of the field **type**: there are three kinds of answers: a/o/n (a/o/n, Always, Often, Never), y/n (y/n, y, n) or text.

The tool shall manage the dependency between the questions by masking the questions having its dependency parent, id specified in the field **dependent,** negatively answered. In the example in Figure 10, if the question with qipId 1.1.1.1 is negatively answered, there is no need to answer the question with qipId 1.1.1.3 and therefore the corresponding question row for qipId 1.1.1.3 in the assessment table should be disabled.

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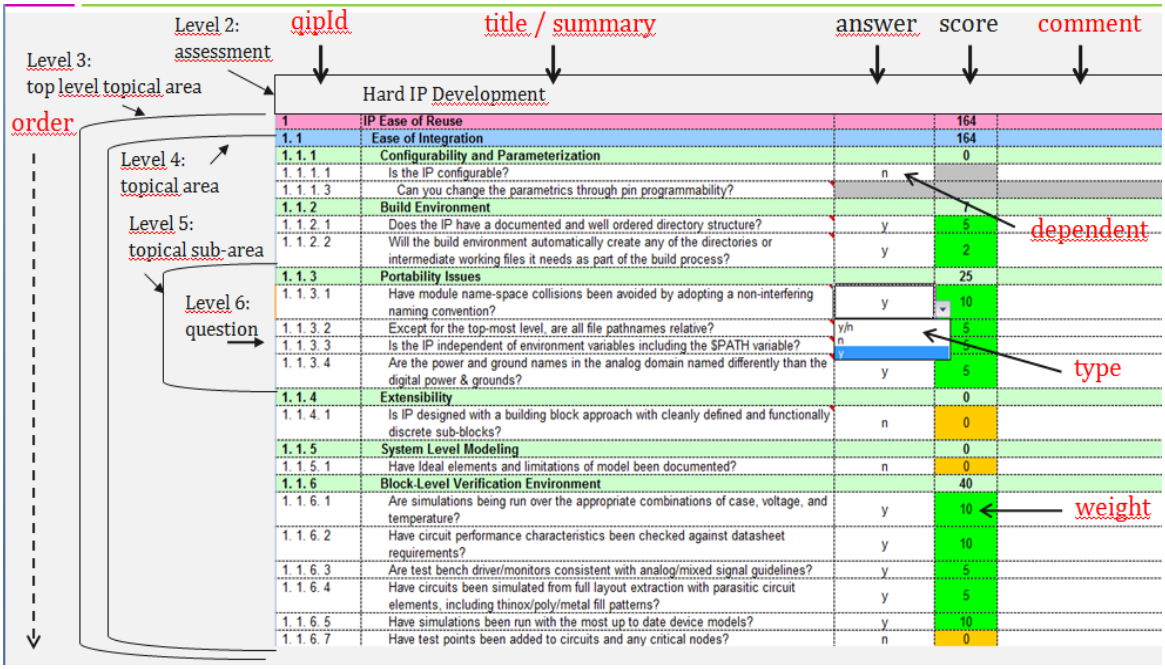

Figure 10— Illustration with the QIP Excel

5.3.6 Scoring and Consolidation

The tool shall assign the value of the field **weight** of the element criterium to the score of a question answered positively, and 0 otherwise. The score of a question shall be displayed in the corresponding questions row of the assessment table.

The tool shall hierarchically consolidate the scores by summing the values and display the consolidated values in the headers of the topical sub-areas sections (if any), in the headers of the topical areas sections, and in the headers of the top level topical areas sections.

The tool should also create and display different summary tables:

— Consolidated scores for the different classes of questions: Imperative not satisfied; Rules and Guidelines not satisfied; Satisfied Imperatives, Rules and Guidelines. The tool shall use the field **class** of the element criterium to identify the class of a question.

— Percentage of points obtained out of the total possible points, per top level topical area, per assessment table, for a group of assessment tables.

QIP is a tool to help to objectively contrast alternatives and make an informed decision. QIP does not give pass or fail grades. Only the IP User can make that decision based on the specific assessments and applicability to their end application.

5.4 Relationship between golden xml and completed xml

The answer XML file is used to communicate only the answers and comments to the questions of the QIP. The criteria (or questions) are identified by the attribute and contains only the elements answer and comment.

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The answer XML file is lighter than the golden XML file and the correspondence between the two XML files is achieved with the attributes id of the criteria.

The tool shall read and write answer XML files to formally exchange the QIP assessment results. The list of QIP criteria (or questions) is loaded once by reading the complete golden XML file and then only the needed data for the answers and the comments to the questions are exchanged, allowing better performances than reading a complete description each time. Moreover, changes can be done in the description of the criteria without impacting existing QIP assessments recorded as answer XML files (knowing that the reference id itself cannot be changed).

The tool shall read and parse the answer XML file, check the semantic of the imported XML file with the answer XML schema, and store the answer and comment fields from the XML structure in a data structure format, using the attribute id for criteria mapping. The golden XML schema file is accessible on the IEEE repository via internet at the URL: https://secure.edacentrum.de/standardisierung/qip/qip_answer.xsd

If an error is detected during the answer XML file import, the tool shall display an explicit message with the detailed information for debugging and stop the import operation without updating its internal data structure. By way of example, an error shall be generated if the imported file is not compliant with the answer XML schema "qip_answer.xsd". For example, Figure 11 shows a possible means to display a field name error.

Figure 11— Answer XML import error

Alternately, a tool that is capable of running in batch mode should output a file with a return code for error reporting. If no errors are detected during the answer XML file import, the tool shall update its internal data structure with the information provided in the answer XML file.

The tool shall write the QIP assessment results by translating the answer and comment fields from its internal data structure format to the answer XML file. The tool shall use the answer XML schema to export the answer XML file with the expected semantic. The answer XML schema file is accessible on the IEEE repository via internet at the URL: https://secure.edacentrum.de/standardisierung/qip/qip_answer.xsd

5.5 User Extensions

An IP integrator may request, or an IP provider may provide, additional quality criteria beyond what is defined in the QIP schema. The IP provider's quality assessment tool should support the addition of criteria, without losing any of the pre-defined quality criteria. The new criteria shall be formatted in the same manner as the other criterium elements, including:

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- **subTypes** element
- **summary** element
- **comment** element
- **author** element
- **type** element
- **class** element
- **weight** element

The **validSince** and **invalidSince** elements are optional. The element **dependent** shall be used if the current criterium depends upon another criterium. A slightly different numbering scheme shall be used to immediately differentiate the user extended criteria from the pre-defined criteria.

The IP integrator's quality assessment tool shall be able to read these additional criterium, but should flag that they have been included.

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6. Compatibility with VSIA QIP

While the intent of this standard is to be compatible with the VSIA QIP, several idiosyncrasies with the previous excel implementations have necessitated some changes. For continuity, the VSIA kept the original question numbering from version 2.0 through its final release of version 4.0, with a few exceptions. This resulted in some variations in question number sequencing. For example, a question that may have been re-categorized from one sheet to another, kept the same ID number as was assigned in version 2. An example of this is the question pertaining to training for an IP. This was originally on the "Vendor" assessment sheet in the "Support" category. However, because the criteria on the "Vendor" assessment should be generic and applicable to all IP that are supplied, the question was moved to the "Integration" assessments in the "IP Ease of Reuse" topic, resulting in non-sequential ID numbers: 1.1.1, 1.1.2, 1.1.3, 1.8.7, etc. Note that these numbers correspond to the qipId-XML-schema-attribute that has been maintained for backward compatibility with the VSIA QIP, and not the unique id-XML-schema-attribute. The latter attribute is the one used in the answer XML for validation with the schema.

Two examples of the VSIA continuity numbering exceptions referred to above are as follows. In the "Ease of Synthesis" section in the "Soft IP Integration" assessment. VSIA Version 2 used the IDs 1.3.8.2 and 1.3.8.4, but these were sequentially renumbered in a later VSIA release to 1.3.8.1 and 1.3.8.2. In the "Design for test and manufacturing" section, VSIA Version 2 used the IDs 2.1.6.1, 2.1.6.2, 2.1.6.3, 2.1.6.6 and again, these were sequentially renumbered in a later VSIA release to be 2.1.6.1-4. The latter numbering in both examples is what is supported by this standard.

It is beyond the scope of this document to detail all of the historical changes in the VSIA excel versions. However, there are some differences between the implemented QIP schema and the most recent VSIA release, version 4, which has been used as the golden reference for this work. Users who want to port previously completed QIP excel's should be aware of these differences listed in Table 1 below:

Assessment Type	VSIA QIP v4 ID	IEEE QIP v1 ID
Digital Verification IP	1.2.3	1.2.2.3
Digital Verification IP	1.2.2.3	1.2.2.4
Digital Verification IP	1.8.7	1.2.3.5
HardIP Int	1.8.7	1.1.1.4
HardIP Int	1.2.3	1.1.1.5
HardIP Int	1.1.1.5	1.1.1.6
Soft IP Integration	1.8.7	1.1.4
Soft IP Integration	1.2.3	1.1.5
Soft IP Integration	1.1.5	1.1.6

Table 1—ID Changes

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Annex A

(informative)

Bibliography

[B1] IEEE Std 1364™, IEEE Standard for Verilog Hardware Description Language.

[B2] IEC/IEEE 61691-1-1, Behavioral languages—Part 1: VHDL language reference manual.[5][6]

[B3] ISO/IEC 8879, Information processing—Text and office systems—Standard Generalized Markup Language (SGML).[7]

[5] IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3, rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iec.ch/). IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (http://www.ansi.org/).

[6] IEEE publications are available from the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, Piscataway, NJ 08854, USA (http://standards.ieee.org/).

[7] ISO/IEC publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iso.ch/). ISO/IEC publications are also available in the United States from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (http://global.ihs.com/). Electronic copies are available in the United States from the American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (http://www.ansi.org/).

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Annex B

(normative)

Semantic consistency rules

For a QIP document or a set of QIP documents, to be valid they shall, in addition to conforming to the QIP schema, obey certain semantic rules. While many of these are described informally in other sections of this document, this chapter defines them formally. Tools generating QIP documents shall ensure these rules are obeyed. Tools reading QIP documents shall report any breaches of these rules to the user.

B.1 Rule listings

Most of the semantic rules listed here can be checked purely by manually examining a set of QIP documents.

B.1.1 Assessment summary

Table B.1—Assessment summary

Rule Number	Rule	Notes
1.1	The name of the IP vendor shall be included	
1.2	The name or part number of the IP that is being assessed shall be included.	
1.3	The highest level topical area shall be for the type of assessment	Vendor Assessment Soft IP Integration Soft IP Development Hard IP Integration Hard IP Development Verification IP Software IP
1.4	Hard IP types shall be defined for all hard IP assessments	Digital Analog/AMS I/O & ESD Memory MEMS
1.5	The technologies associated with Hard IP shall be included	
1.6	The assessment type shall be defined for all assessments	Vendor Vendor & Integration Vendor, Integration & Development

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B.1.2 Questions and numbering

Table B.2—Questions and numbering

Rule Number	Rule	Notes
2.1	Question text cannot be changed	
2.2	Each question has a unique numerical identifier	
2.3	If a question is retired, the numerical identifier is also retired	
2.4	If a question is added, a new unique numerical identifier is also added and associated with the question	
2.5	Questions shall be grouped by topical areas	
2.6	The topical areas shall form the basis of the numbering scheme	
2.7	Up to three sub-areas may be used for each top level topical area	
2.8	Questions shall be as brief as possible, but additional remarks may be included	

B.1.3 Question handling

Table B.3—Question handling

Rule Number	Rule	Notes
3.1	Questions shall be classified as Imperative, Rule, Guideline, Optional, Mitigable	
3.2	Optional questions when answered “y”, shall enable the subsequent detailed questions that are dependent on the optional question	
3.3	Optional questions when answered “n”, shall disable the subsequent detailed questions that are dependent on the optional question	
3.4	Optional questions when answered “n”, the subsequent detailed questions shall be removed from the completion and scoring metrics	
3.5	Legal question answer options cannot be changed	

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3.6	Questions shall be quantitative and answerable by yes or no (“y” or “n”).	When unavoidable, always / often / never (“a” or “o” or “n”) may be used for guideline weighted questions only. The ESD Rating questions for hard IP integration assessments require textual answers that should be included in the comment fields.
3.7	All questions shall have a free text field for additional explanatory comments.	
3.8	Questions that are not applicable to the IP being assessed shall be answered “n” or “never” and “N/A” or “not applicable” shall be entered into the comment field.	
3.9	Hard IP questions may be duplicated in a single Answer XML file to differentiate criteria results for the same IP in different technologies.	The qipID shall be replaced with the secondary technology

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2 **B.1.4 Hierarchy**

3 **Table B.4—Hierarchy**

Rule Number	Rule	Notes
4.1	The top-level of hierarchy is the View	
4.2	The second level is the Area of Concern	
4.3	The third level may be Topics	
4.4	Beneath the lowest applicable hierarchical category are questions	
4.5	All questions and their Topic header row are grouped together so that it is possible to collapse the display to just the header row.	
4.6	All Topics and their Area of Concern header row are grouped together so that it is possible to collapse the display to just the header row	
4.7	All Areas of Concern and their View header rows are grouped together so that it is possible to collapse the	

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	display to just the header row	

B.1.5 Usage

Table B.5—Usage

Rule Number	Rule	Notes
5.1	IP Providers, or those completing the metric, may not change any question classification, weight or legal answer	
5.2	IP Users, or those evaluating the metric, may change only the classification (imperative, rule, etc) of the questions to customize for their applications	

B.1.6 Scoring

Table B.6—Scoring

Rule Number	Rule	Notes
6.1	Questions grouped by topical areas and corresponding Question scores shall roll up into Topical scoring.	
6.2	Topical scoring shall roll up into Overall score for the IP.	
6.3	Imperatives shall be assigned a weight of 10 points	y = 10pt, n=0pt
6.4	Rules shall be assigned a weight of 5 points	y=5pt, n=0pt
6.5	Guidelines shall be assigned a weight of 2 points	y=2pt, n=0pt a=2pt, o=1pt, n=0pt
6.6	Optional questions have no weight	
6.7	Mitagable questions have no weight, however are counted as a “Rule” in the question count roll up.	
6.8	Section scoring (Topical or Overall) is equal to the % of points obtained out of the total possible points possible for questions answered	

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B.1.7 Display

Table B.7—Display

Rule Number	Rule	Notes
7.1	Overall score summary table lists IP overall score (% of pts scored out of total possible).	
7.2	Overall score summary table lists the number of questions answered unsatisfactorily as a "Traffic Light" visual	The Imperatives, marked in red for "Danger," are the most important questions. (At a minimum, if this were a real product, you would want all Imperative questions satisfied.) The Rules and Guidelines that were not satisfied, which are marked in orange/yellow for "Caution," are of lesser importance. Questions that received satisfactory answers are marked in green for "Go."
7.3	Topical summary table separately displayed for each high level area	Vendor Assessment, Soft IP Integration, Soft IP Development, Hard IP Integration, Hard IP Development, Verification IP, Software IP
7.4	Topical summary table shall list the Topical area score	(% of pts scored out of total possible
7.5	Topical summary table lists the number of questions from Topical area answered unsatisfactorily as a "Traffic Light" visual	The Imperatives, marked in red for "Danger," are the most important questions The Rules and Guidelines that were not satisfied, which are marked in orange/yellow for "Caution," are of lesser importance. Questions that received satisfactory

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		answers are marked in green for "Go."
7.6	Topical summary table should have ability to drill down to individual questions contained in the topical area	Question details should show question, assessment, score, comments, and question importance (Imperative, Rule, Guideline, or Optional) for each question. Based on question response, the question score shall have Traffic light color coding: Red = Danger = An imperative not being met (i.e. an "n" answer), Orange/Yellow = Caution = A Rule or Guideline not being met (i.e. an "n" answer), Green= Go = Question answered satisfactory.

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2 **B.1.8 User extensions**

3 **Table B.8—User extensions**

Rule Number	Rule	Notes
8.1	Additional user specific criterium shall follow the same format as the pre-defined quality criteria	
8.2	The qipID for user specific criterium shall be preceded by the letter "v".	
8.3	The qipID for user specific criterium shall be based on the topical areas numbering scheme	

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